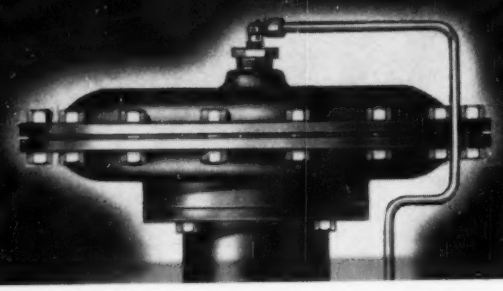
Instruments and AUTOMATION

Trade Mark Applied For

X-band rigid components receive swept-frequency discrimination tests at Titeflex, Inc. Equipment shown for the tests include Klystron power supply, Sperry 208A frequency meter, PRD 204A slotted section, WTC variable transformer, Dumont 304H oscilloscope, Hewlett-Packard 415A standing wave indicator, Hewlett-Packard 430B microwave power meter, Sperry 213 barretor mount, Measurement Corp. 71 square-wave generator, Dystron, PRD 177A attenuator, meters by Weston, and plumbing by Titeflex, Inc.

Vol. 27 No. 2
FEBRUARY • 1954

FISHER® POSITROL®



FOR ACCURATE POSITIVE VALVE POSITIONING

WA
PAG

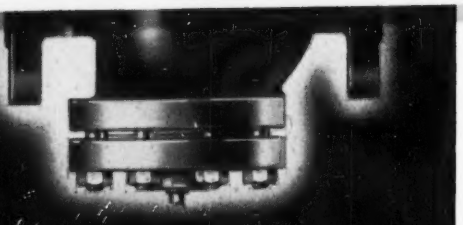
FEATURES

- COMPACT — SIMPLE RUGGED
- 5 YEARS FIELD SERVICE
- EASILY ADJUSTABLE
- FORCE BALANCE TYPE OF POSITIONER
- AVAILABLE WITH OR OUT BY-PASS
- USABLE AS REMOTE TION INDICATOR
- FOR DIRECT OR R ACTION VALVES

TECHNICAL DATA

TEST			FISHER TYPE 3500
INSTRUMENT PRESSURE SENSITIVITY CONTROLLING PRESSURE CHANGE NEEDED TO PRODUCE 2 LBS. TO 15 LBS. TO DIAPHRAGM			0.07 LB.
STEM MOVEMENT SENSITIVITY AMOUNT STEM CHANGE TO PRODUCE 2 LBS. TO 15 LBS. TO DIAPHRAGM	½" TRAVEL		.0.0037" AVE
	2" TRAVEL		0.015" AVE
SPEED TIME IN SECONDS FOR FULL TRAVEL	SIZE	TRAVEL	
	DD	¾"	1.2 — 1.2 SEC.
	FF	1½"	4.2 TO 4.8 SEC.
	GG	2"	7.2 SPC TO 9.6 SEC.
	HH	2"	10.5 TO 12.6 SEC.
LAG ERROR IN POSITION AT 9 LBS. CONTROLLER PRESSURE	½" TRAVEL		0.0006" AVE.
	2" TRAVEL		0.001" AVE.
EFFECT OF VARIATIONS IN AIR SUPPLY PRESSURE	½" TRAVEL		0.1 LB. PER 5 LB. CHANGE
	2" TRAVEL		0.1 LB. PER 5 LB. CHANGE
CHARACTERISTICS CONTROLLED P VS. DIAPHRAGM P			LINEAR
COMMENTS			STABLE ADJUSTMENTS ALL EASY AND SIMPLE
AIR CONSUMPTION NORMAL 9 LBS. DIAPHRAGM PRESSURE			15.0 CU FT/HR

FOR COMPLETE DETAILS WRITE FOR BULLETIN E-3500.



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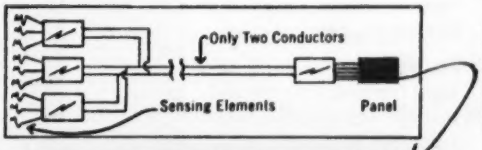

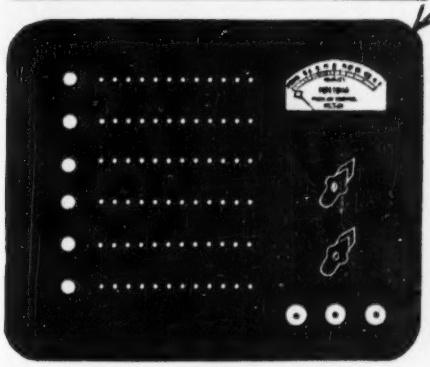

• Alarm and meter indicate failure of any circuit element.

PANEL SIZE MINIMIZED

Zone alarm lights. Point alarm lights. Meter for direct temperature reading. Zone switch. Point switch. Indicator lamp test button. Reset button. Horn turn off.

NOW BEING DEMONSTRATED. ***Write for Specifications 2***

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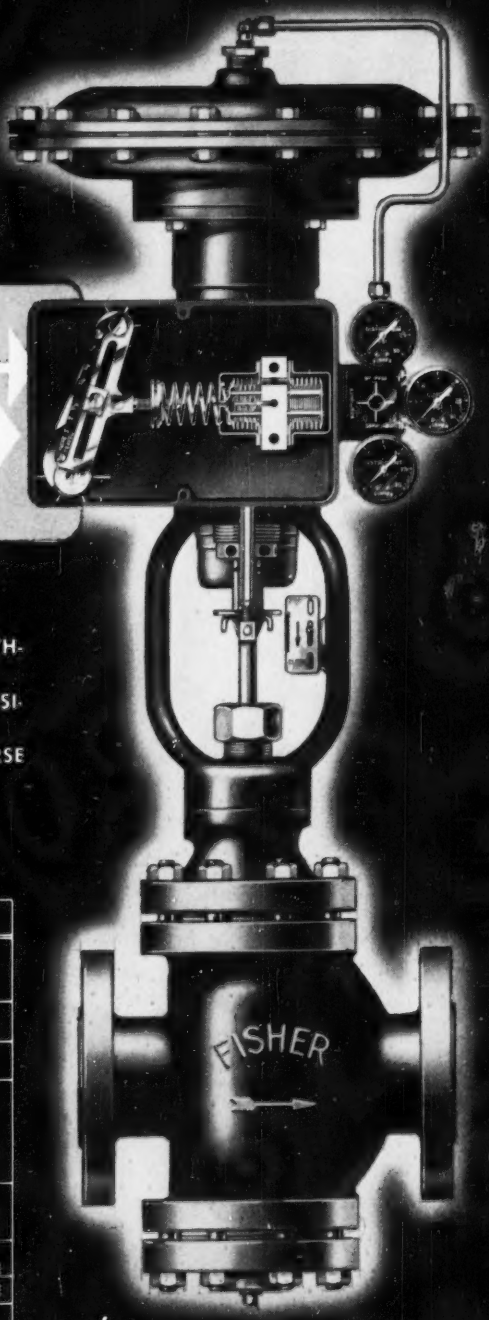

FEATURES

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- EASILY ADJUSTABLE
- FORCE BALANCE TYPE OF POSITIONER
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FOR COMPLETE DETAILS WRITE FOR BULLETIN E-3500

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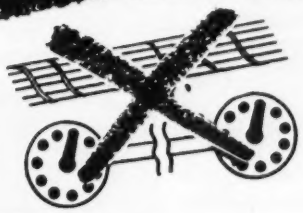

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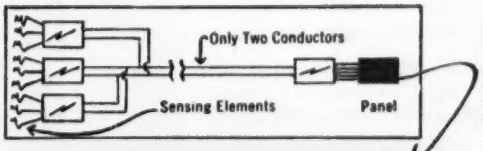
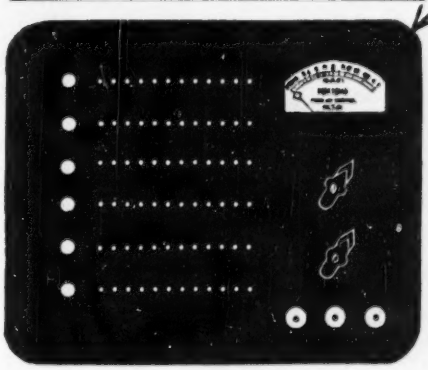
Completely Non-Mechanical and utilizing only two conductors





Features:

LOWEST INSTALLATION COST

- Utilizes one inexpensive RG-59/U coaxial cable instead of 200 conductors in an average installation of 100 points.

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- Zone and point alarms.
- Point temperature readings.
- Uninterrupted scanning and alarm indication during temperature reading.

SELF MONITORING

- Alarm and meter indicate failure of any circuit element.

PANEL SIZE MINIMIZED

Zone alarm lights. Point alarm lights. Meter for direct temperature reading. Zone switch. Point switch. Indicator lamp test button. Reset button. Horn turn off.

NOW BEING DEMONSTRATED. ***Write for Specifications 2***

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Instruments and AUTOMATION

Vol. 27 **February 1954** No. 2

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to USAF Specification 32659

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AVAILABLE IN AWG SIZES FROM #20 TO #4/0

AWG	AWG	AWG
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18	8	0
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14	4	000
12	2	0000

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Barton's engineering skill produced the truly rupture-proof bellows design that has made its mark in the metering field . . . covering Chemicals, Petroleum and Gas transmission.

Barton sales representatives are always ready to help solve your metering problem. They can show you why Barton flowmeters require no specially trained personnel and require practically no service.

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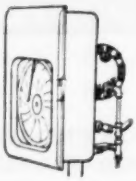

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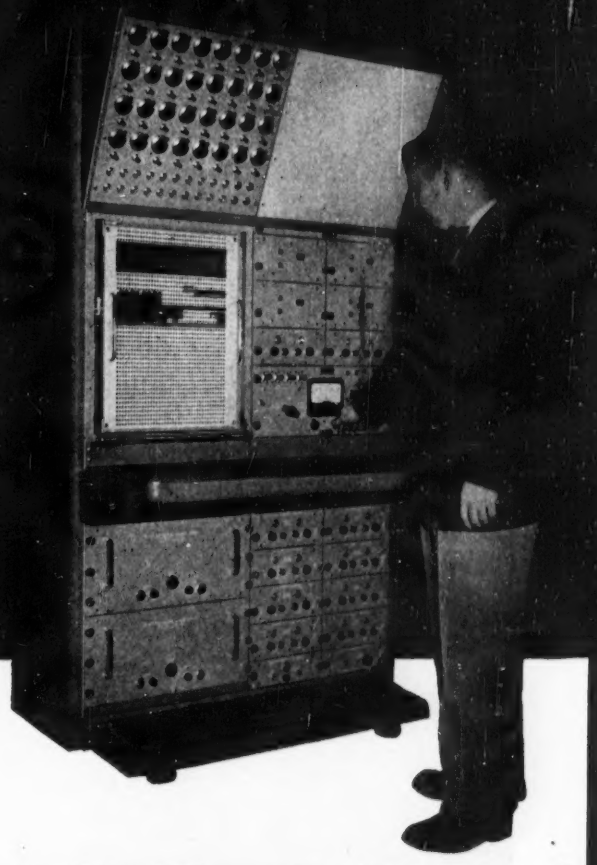

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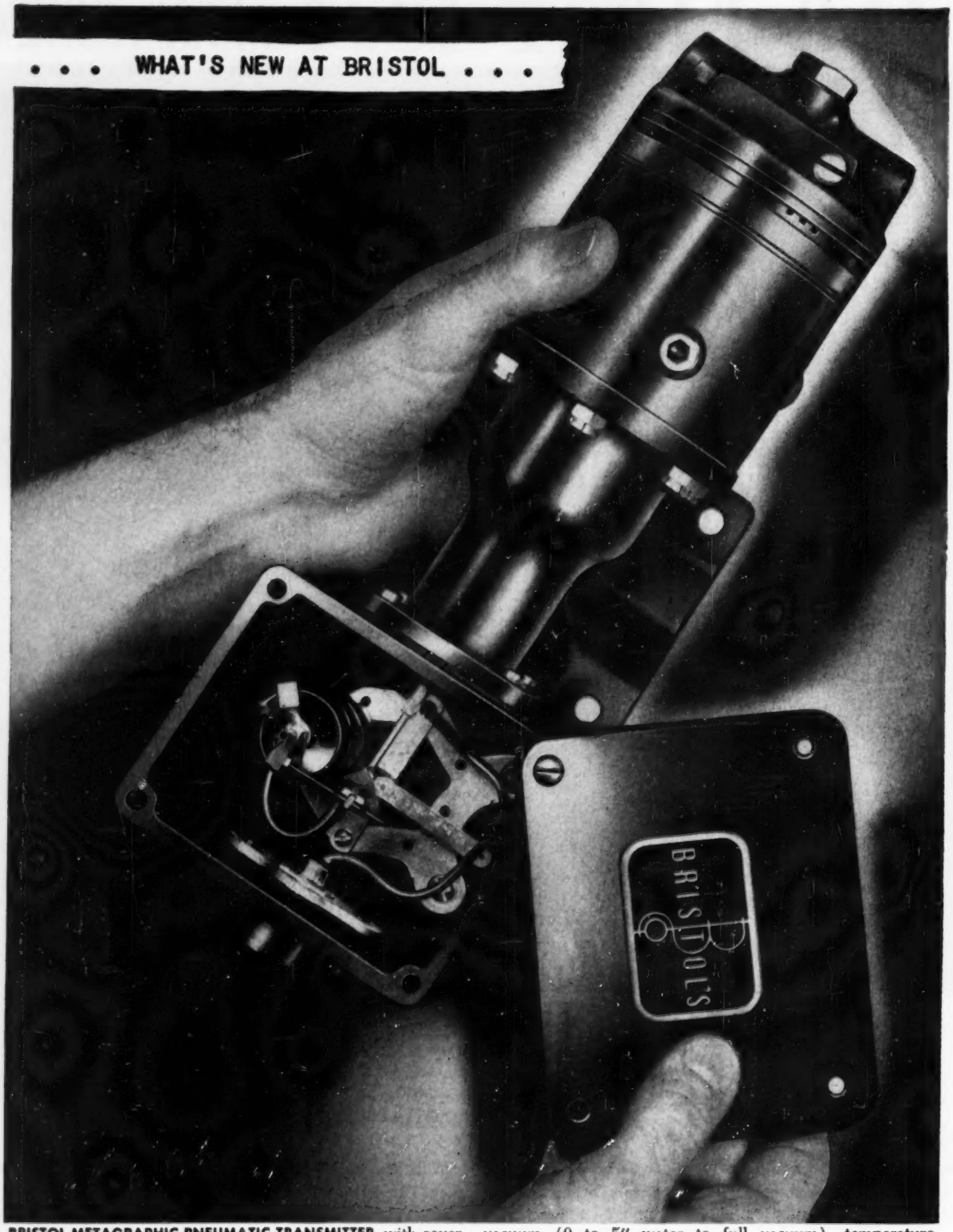

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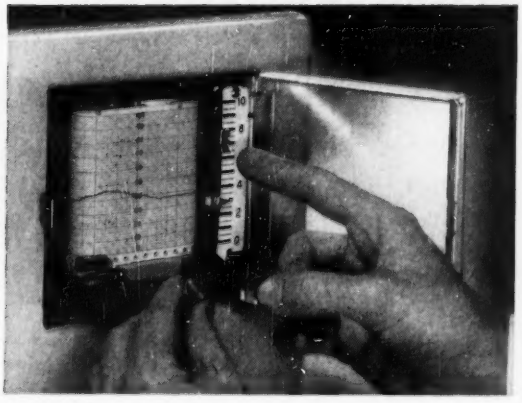
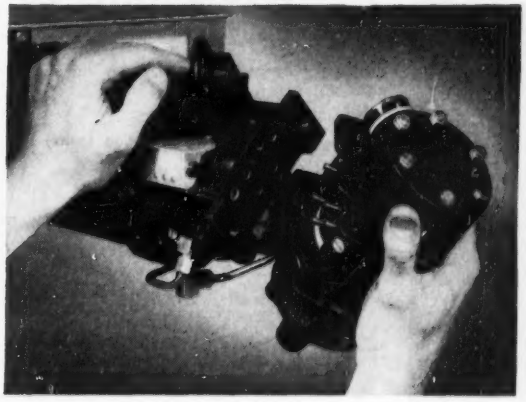
- **WEIGHS ONLY 7½ POUNDS,** is weatherproof and can be installed in any location and operate in any position.

Get the whole story on the Metagraphic transmitters. Write for free bulletin A105, to The Bristol Company, 113 Bristol Road, Waterbury 20, Connecticut.

Meet the rest of the Metagraphic family . . .



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned a reputation as the "biggest little instrument in the industry". The continuous valve-position indication, separate from set-point indication, gives continuous data on control valve position and process level.



THE BRISTOL CONTROLLER can be plugged into back of receiver, placed at process. Available in on-off, proportional, proportional plus reset, proportional plus derivative, and proportional plus reset plus derivative. Experienced instrument men will recognize this as a unit* service-proved in thousands of installations.
*Licensed under C. B. Moore patents

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

For more information circle **7** on inquiry card.

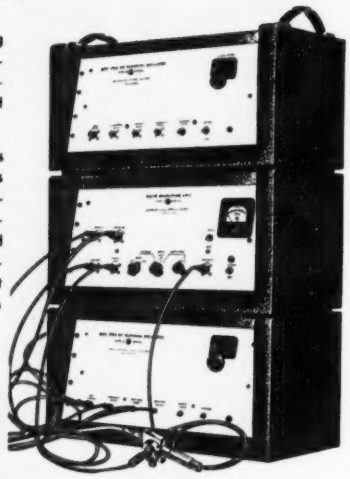
PRECISION ENGINEERING

THE TYPE 20 INSTANTANEOUS READING

BROAD-BAND SWR INDICATOR

The AIL type 20 SWR Indicator System consists of two separate Scanning Oscillators covering the 400-900 mc and 900-1350 mc bands, a Reflectometer with a standard matched 50-ohm load, a Ratio Measuring Unit, interconnecting and power cables. Frequency and SWR over the entire band are displayed on an oscilloscope (not supplied).

- Instantly measures standing wave ratio over the 400-900 mc and 900-1350 mc bands.
- Eliminates tedious point-by-point data taking.
- Adjust antennas, transmission systems, filters, networks, receivers while under test.
- The Scanning Oscillators may be used separately as sources of r-f power, automatically scanned or manually adjusted to the desired frequency, giving 200-milliwatt minimum power output over the band into a 50-ohm resistive load.



Type 20 SWR Indicator System, Complete with Interconnecting Cables less oscilloscope

Low Frequency System	$2,980
High Frequency System	2,980
Complete High and Low Frequency Systems	4,200

F.O.B. Mineola. Prices for individual units may be obtained upon request.

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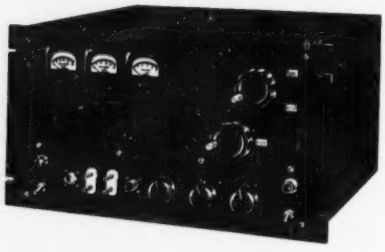
Continuous control within ranges from 300 to 900 mc and 900 to 2,500 mc

Separate output coupling control

More than 10 W to 1200 mc

More than 2.5 W to 2,500 mc



The AIL type 124A Oscillator consists of a grid-separation coaxial oscillator employing a 2C39A disc seal triode, an audio oscillator and a modulation section.

Write for a detailed description of its versatility and operating ease.

$2,285.00 F.O.B. Mineola

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Perhaps we can be of service to your organization. Your inquiry will receive prompt attention and will be handled in confidence.

Write for complete literature on these items, or AIL custom design and manufacturing service on other precision instruments and components.

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The AIL type 373A Rectangular Coordinate Recording System has the accuracy of a precision laboratory instrument, yet its rugged construction recommends it for field use. Fills a variety of recording needs where fast plotting and permanent records are required.

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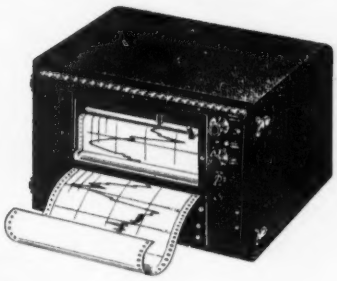
Acoustics	Reverberation-time studies Directional characteristics of microphones and loud speakers Frequency response curves
Atomic Research	Counting rates Monitoring process control

Provides in rectangular coordinates a continuous inked plot of voltage, as a function of either angular position or time. Two-microvolt sensitivity.

Available to provide logarithmic or linear recording of input voltage.



Full scale (10 inches) pen deflection in one quarter second.

Paper speed up to 10 inches per second.

Write for information today.

$8,500.00 F.O.B. Mineola, N. Y.

For more information circle 8 on inquiry card.

MICROWAVE CRYSTAL TESTER

checks microwave crystals easily—accurately

Measures:	Relative Noise Figure Relative Sensitivity Match of Crystal Pairs Conversion Loss Noise Temperature
Uses:	Field test set to determine receiver sensitivity, as determined by crystal quality Laboratory test set to choose representative and extreme crystals from a group Crystal inspection test set

Tests crystals without removing them from the receiver

Accepts both ceramic cartridge and coaxial types, normal or reversed polarities

AIL Type 390A-3

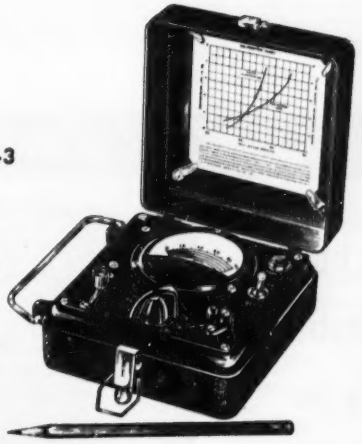
Accurate

Portable

Self-Contained

$97.00

F.O.B. Mineola

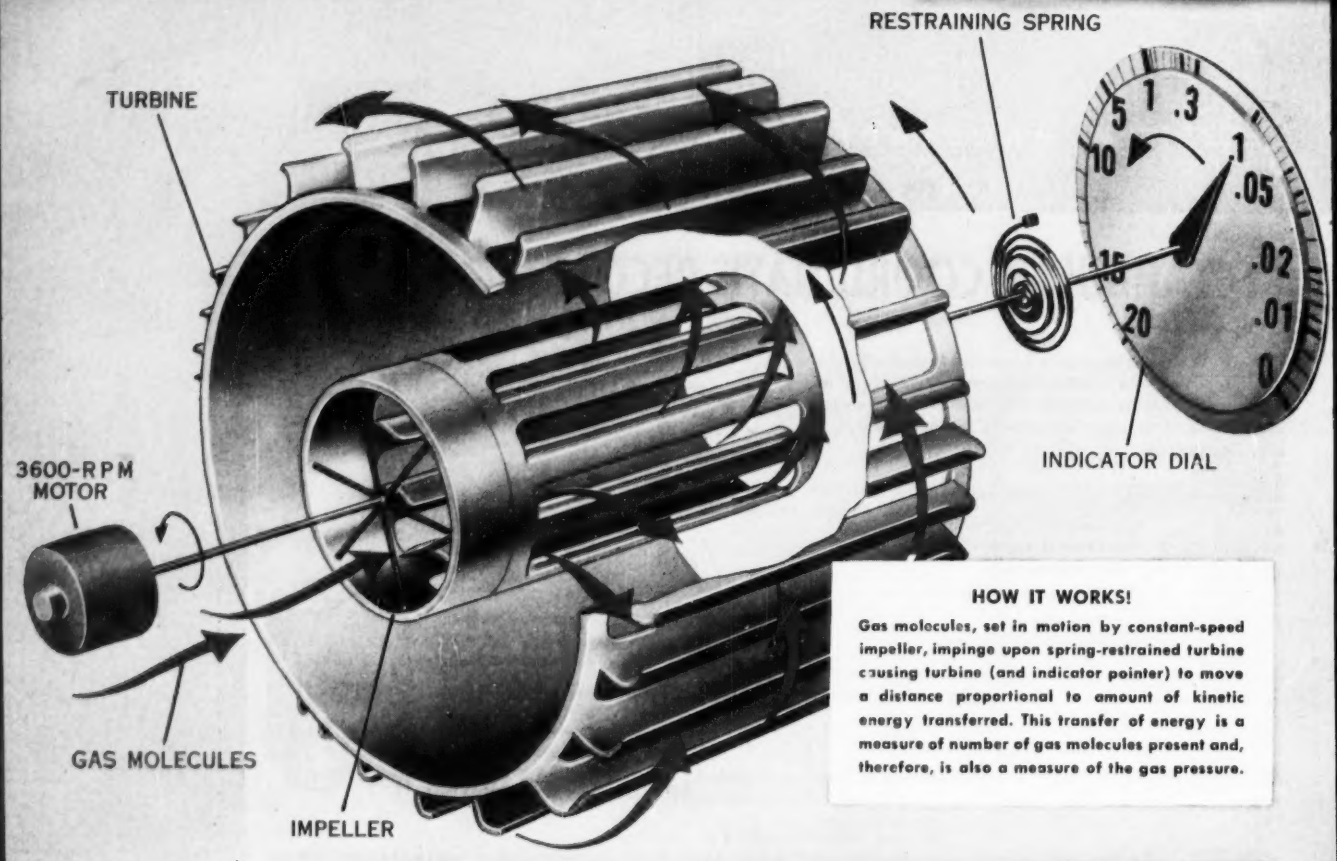


For more information circle 9 on inquiry card.

AIRBORNE INSTRUMENTS LABORATORY

INCORPORATED

160 OLD COUNTRY ROAD, MINEOLA, L. I., N. Y.



HOW IT WORKS!

Gas molecules, set in motion by constant-speed impeller, impinge upon spring-restrained turbine causing turbine (and indicator pointer) to move a distance proportional to amount of kinetic energy transferred. This transfer of energy is a measure of number of gas molecules present and, therefore, is also a measure of the gas pressure.

HIGHLY VERSATILE, the new G-E molecular vacuum gage is supplied with a scale for the direct reading of dry air (between 0 and 20 millimeters), or with a linear scale which may be easily calibrated for other gases. The device is therefore well suited for laboratory and research work in the fields of vacuum metallurgy and metal purification, outgassing of impregnates, distillation of low-boiling compounds, vacuum coating and plating, dehydration of heat-sensitive materials, and vacuum extraction and solvent recovery.

News About Other General Electric Instruments for Precision Measurement in the Laboratory

PORTABLE DOUBLE BRIDGE

LOW-RESISTANCE MEASUREMENTS, 0.0001 to 22 ohms, are easily and accurately obtained with the G-E portable double bridge. Highly accurate, portable, and entirely self-contained, the instrument is priced at $334.62.*

INSULATION-RESISTANCE METER

UP TO 20,000 MEGOHMS may be quickly and accurately measured on four scales of the insulation-resistance meter. With maximum-output current limited to 2 ma, greater operator's safety is assured. $304.20.*

*Manufacturer's suggested retail price.

For more information circle 9 on inquiry card.

GENERAL ELECTRIC ANNOUNCES . . .

Revolutionary New Molecular Vacuum Gage

SIMPLIFIED VACUUM MEASUREMENT • EASY OPERATION • EASY INSTALLATION

Similar to a "fluid clutch" in principle of operation, this new entirely mechanical molecular vacuum gage overcomes many of the problems encountered in the use of other type vacuum gages.

NO PRIMARY ELEMENT TO BURN OUT

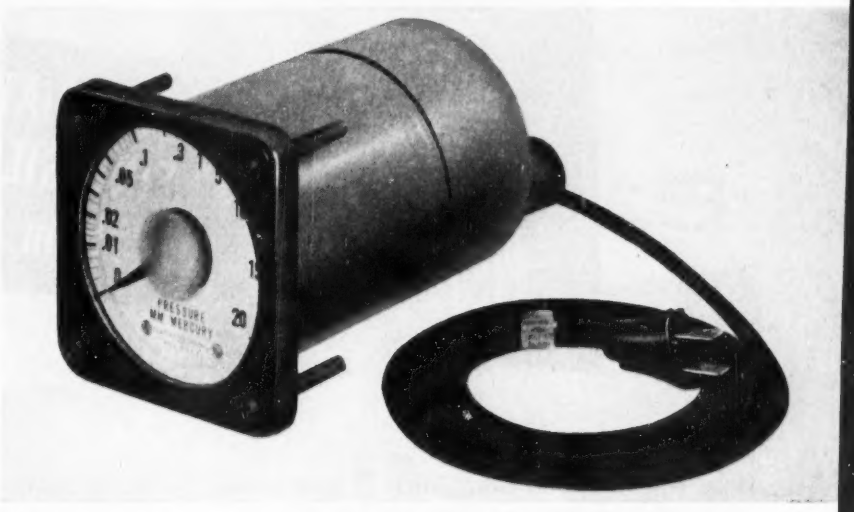
Having no electronic tubes or other electrical detecting devices, the new General Electric molecular vacuum gage assures continuous operation without time-consuming delays caused by electrical failure such as tube burnout.

UNHARMED BY ATMOSPHERIC PRESSURE

Because this new device may be opened to atmospheric pressure suddenly, without damage to the instrument, it is especially valuable where personnel may be untrained in the use of complicated instruments.

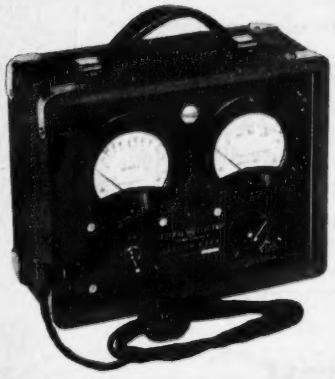
FURTHER INFORMATION

Price is $195.00.* For further details, check coupon for Bulletin GEC-986.



EASY-TO-OPERATE, the molecular vacuum gage requires no complicated setting of control knobs. Direct-reading, the instrument calibration remains unaltered through continuous operation. The long scale span in the high-vacuum range, and the highly legible numerals of the indicator dial assure accurate readings. Face-plate studs facilitate panel mounting.

THERMOCOUPLE VACUUM GAGE



THERMOCOUPLE POTENTIOMETER

SECTION B605-73
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, N. Y.

Please send me the following bulletins:

- ☐ Molecular Vacuum Gage (GEC-986)
- ☐ Portable Double Bridge (GEC-251)
- ☐ Insulation-resistance Meter (GEC-753)
- ☐ Thermocouple Vacuum Gage (GEC-385)
- ☐ Thermocouple Potentiometer (GEC-245)

Name .....
Company .....
Street .....
City ..... Zone ... State .....

VACUUM MEASUREMENT with this instrument eliminates need for permanent test panels, lowers investment costs. Gage provides continuous indication, fast response. Price is $117.59.*

ACCURATE THERMOCOUPLE TEMPERATURES are quickly and easily determined with this portable instrument. Valuable when making temperature surveys, this self-contained potentiometer is priced at $198.90.*

GENERAL ELECTRIC

For more information circle 9 on inquiry card.

NOW...

IMMEDIATE DELIVERY of FINE-SILVER CONTACTS ...from MALLORY STOCK!

Here is another Mallory "first"! A standard stock program on fine-silver headed rivet contacts makes possible immediate shipment of most requirements.

Engineering analysis of thousands of customer prints resulted in the selection of 70 flat and radius faced fine-silver headed rivet contacts to be carried in stock. These designs are suited to thousands of varying applications. The advantages to our customers are obvious . . .

- ***Prompt shipment, normally within 24 hours.***
- ***Saving in time and cost of special designs and tooling.***
- ***Immediate availability of samples, where required.***
- ***Ready availability of small quantities for pilot runs and job orders.***

Write today for the leaflet listing dimensions, prices and part numbers of the 70 standard stock Mallory Contacts. It has been designed for quick checking against your present requirements and also for reference in your new design work.

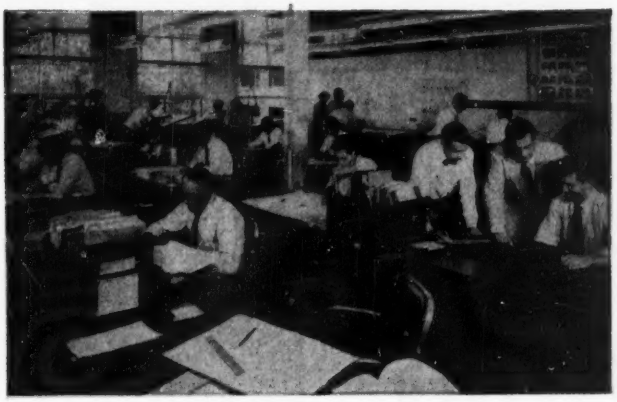
If the special nature of your design requires special contacts, call on the specialized experience of Mallory engineers. Modern facilities and a complete range of materials are available to produce contacts or contact assemblies to meet your requirements.

Expect more... Get more from **MALLORY**

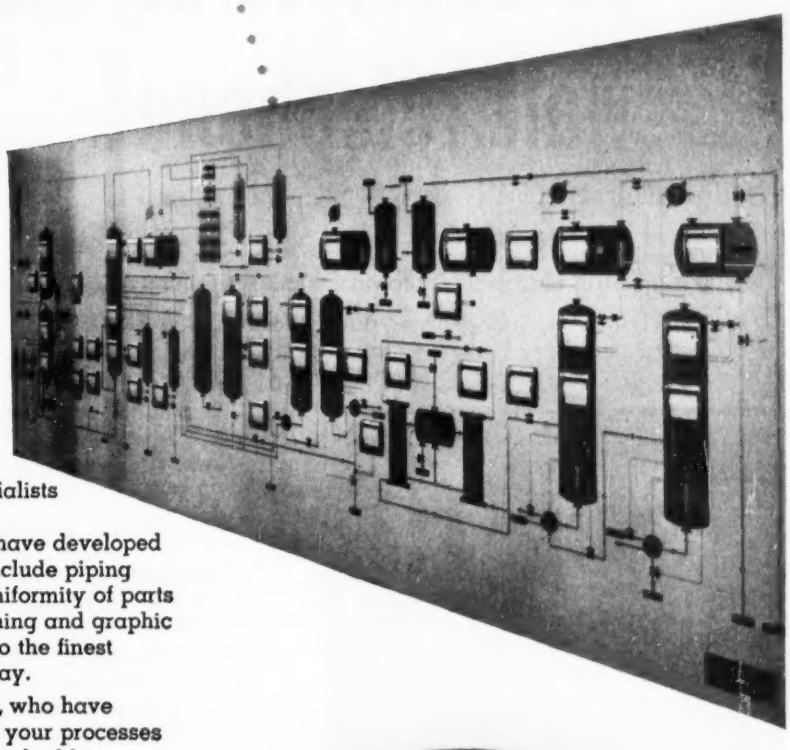
P R MALLORY & CO Inc
MALLORY
P. R. MALLORY & CO. Inc. INDIANAPOLIS 6, INDIANA

Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

For more information circle **10** on inquiry card.



engineered GRAPHIC PANELS by FOXBORO



Working as a team, Foxboro Panel and Process Control Engineers offer you an unequalled resource . . . one which will assure you of the most efficient instrumentation, and the most practical panel layout, for your process.

Foxboro Panel Engineers are specialists in panel design and fabrication. Exclusive techniques which they have developed over many years of experience include piping arrangements, wiring methods, uniformity of parts and accessories, methods of finishing and graphic portrayal — all of which add up to the finest graphic panel work available today.

Foxboro Process Control Engineers, who have specified the right instruments for your processes over the years, are applying this valuable experience to the integrated control systems which you require today.

Whether we originate the graphic layout from your flow sheet, or work directly from a design of your own, this engineering teamwork will provide you with the ultimate in an operating panel for centralized process control.

If you are planning a new or modernized control room, let us detail a proposal for you, with comprehensive data on Foxboro Graphic Panels.

The Foxboro Company, 462 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO
REG. U. S. PAT. OFF.

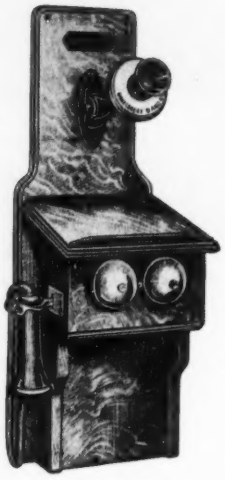
PROCESS CONTROL ENGINEERING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

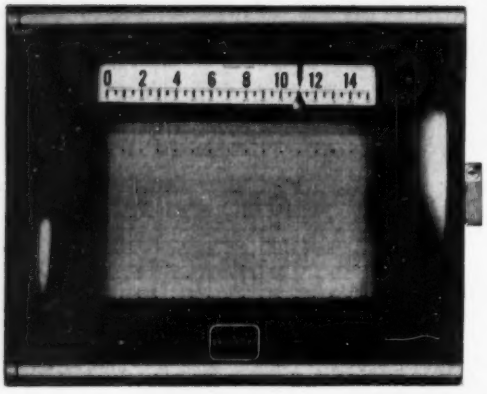
For more information circle **11** on inquiry card.

WHAT'S NEW AT BRISTOL . . . . WHAT'S NEW AT BRISTOL

Bristol makes DRY CELLS in potentiometers as obsolete as the wall telephone!



NEW *Bristol electronic Dynamaster potentiometers and pyrometers give you No-Batt CONTINUOUS STANDARDIZATION without dry cells*



The wall telephone has long since joined the parade to the past.

Now Bristol's development of No-Batt continuous standardization has put dry cells for instrument work in the same category.

Here's what the new Bristol instruments offer:

- **CONTINUOUS STANDARDIZATION** – which eliminates need for dry cells – supplies voltage that is continuously compared with standard cell.
- **CONTINUOUS OPERATION – NO TIME OUT.** With continuous standardization, the potentiometer is free to continuously measure, record, and control. No time out or interruption is required for periodic standardization.
- **NO STANDARDIZING MECHANISM.** Continuous standardization is taken care of electrically. The absence of standardizing mechanism simplifies the instrument considerably.

For the complete story on the modern Bristol Dynamaster, write for free 35-page booklet P1245. The Bristol Company, 113 Bristol Road, Waterbury 20, Conn.

LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL

BRISTOL

THE DEPENDABLE GUIDEPOST OF INDUSTRY

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

For more information circle **12** on inquiry card.

Trends ...

Late News and Comments

Automation—Prescription for Prosperity was title of talk by R. E. Cross, Vice President, The Cross Company, Detroit, before a recent American Society of Tool Engineers' meeting in N.Y. He said: "Machine tools operating without direct labor will be a reality in the near future and will be a major factor in limiting any downward trend in business volume."

National expenditures for scientific and industrial research in 1952 totaled $3¾ billion, of which about 67% was in facilities owned or operated by private industry. Thus, reveals Bureau of Labor Statistics 1148 (available from Supt. of Documents, Washington 25, D.C.), industrial research is by far the largest segment of the nation's research activity.

Capital investment for instruments in many new plants now total 20% of the total plant expenditure—and only a few years ago industry as a whole paid little attention to instrument purchases.

Competition—leading to cost cutting in production—will be featured highlight of industrial 1954. More extensive use of instruments and automation will be inevitable. As stated by Arvid Lundell, President, Colonial Broach Company, Detroit: "The accent is now on competitive modernization with machine tool customers . . . . interested in machines that will do the work with the lowest requirements for man-hours and machine-hours."

New orders are running about 40% ahead of last year, reveals a report released Jan. 27, 1954, by Dr. Walter S. Baird, President, Baird Associates.

Commenting on increased sales figures for scientic apparatus and equipment during 1953, Kenneth Andersen, Executive Vice President, Scientific Apparatus Makers Association, calls the industry's "over-all situation good." Reviewing past years, Andersen cited the tremendous growth of research and development during highly competitive periods and said: "Renewed efforts on the part of manufacturers to cut production costs through use of automatic equipment based on electronic instrumentation--automation--are expected to show a continued growth of industrial instrumentation."

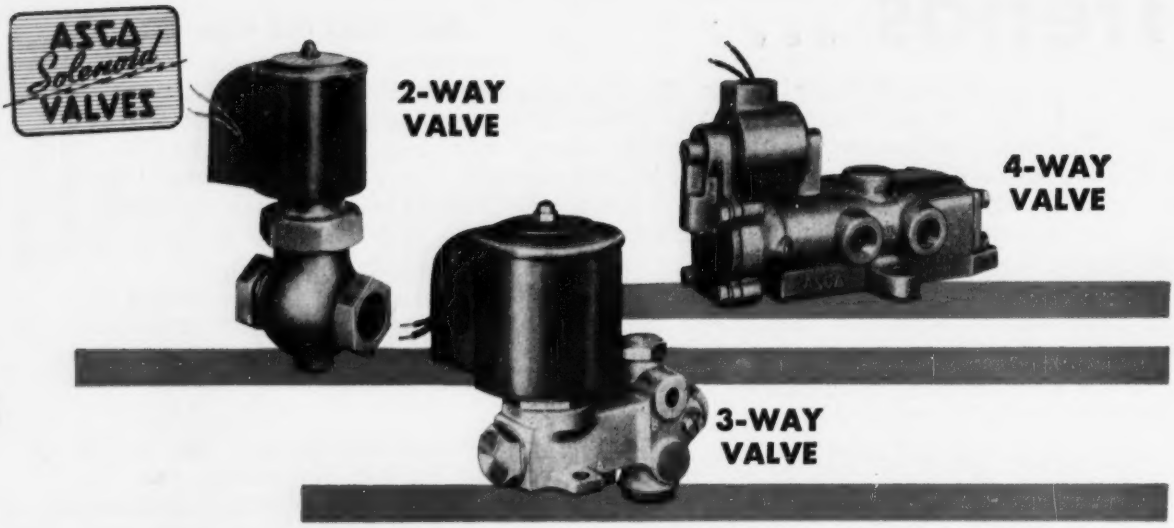
ITV is simmering. While sales of broadcast TV have slumped, the York Report (York Engineering & Construction Co.) states: "Closed circuits—not color—may be the gas under the television kettle this year."

Army Air Force experts who have studied the MIG that landed behind U.S. lines in Korea report that it lacks the instruments and controls that make our Sabre Jet easy to fly. They state that a MIG pilot would be kept so busy "fighting" his plane that he would have little time left for fighting the enemy.

Return of competition will stimulate interest and expenditures for instruments and automation in 1954. In the opinion of Henry Dever, President, Brown Instruments Division, Minneapolis-Honeywell, this will increase substantially the instrument manufacturing share of every capital-expenditure dollar as more potential customers recognize what instruments can do for them.

Today's conditions require more than ever that research be continued on a substantial scale, says Ferdinand Eberstadt, President, F. Eberstadt & Co., New York. As volume slackens, profit margins grow narrower, and development of new and improved products through research becomes essential to survival.

The production line ushered in the first industrial revolution; instruments and automation are producing the second.



OFFERING SELECTIVITY *PLUS*

1237

Different Types of ASCO® Solenoid Valves

792 ... Two-Way Solenoid Valves
• Sizes ⅛ to 6 inches • Temperatures to 600°F • Pressures to 1500 psi • Fully Automatic • Manual Reset • Wide Selection of Body Materials

PLUS

385 ...Three-Way Solenoid Valves
• Sizes ⅛ to 6 inches • Temperatures to 450°F • Pressures to 1000 psi • Fully Automatic • Manual Reset • Wide Selection of Body Materials

PLUS

60 ... Four-Way Solenoid Valves
• Sizes ¼ to 1½ inches • Temperatures to 212°F • Pressures to 250 psi • Poppet or Slide Type • Brass or Bronze Bodies

MANY VALVES for automatically controlling the flow of liquids and gases

ASCO Solenoid Valves are available with standard, explosion-proof or water tight solenoid enclosures and Class A or Class H coils . . . in a wide range of body materials including stainless steel, cast iron, brass, bronze, etc., . . . with all design and manufacturing backed up by some fifty years of Engineering Leadership in the Solenoid Valve Control Field.

ASCO Engineers at the plant or in key cities will be glad to work with you on your problem and to recommend the best valve, standard or special, for your requirements.

Experience Shows
"THERE'S AN ASCO VALVE FOR EVERY PROBLEM"

Our Valve Catalog No. 24 gives complete up-to-date information on the extensive line of ASCO Solenoid Valves. WRITE FOR YOUR FREE COPY TODAY!

Since 1888
Designers and Manufacturers of Electromagnetic Controls.

Automatic Switch Co.

385-T LAKESIDE AVENUE • ORANGE, NEW JERSEY

For more information circle No. 13 on inquiry card.

Circle No. 14 on inquiry card. ⟶

Here's why it pays to know your **HSM** HONEYWELL SUPPLIES MAN

D. A. Somers, Honeywell Supplies Man in the Philadelphia area, shows Harry Baldwin, purchasing agent of Ajax Engineering Corp., Trenton, N. J., the type of Brown thermocouple protecting tube that will give long life and high sensitivity in an aluminum melting furnace.

Personalized service is the foundation of the HSM Plan. Your HSM man gives you valued assistance not only in selecting the right pyrometer supplies, but also in setting up a custom-fitted plan for buying that can cut your inventories, simplify purchasing . . . and save you a big percentage of your annual supplies bill.

Hundreds of companies are now using this Plan. Your nearby HSM will be glad to discuss how it can work in your own plant . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

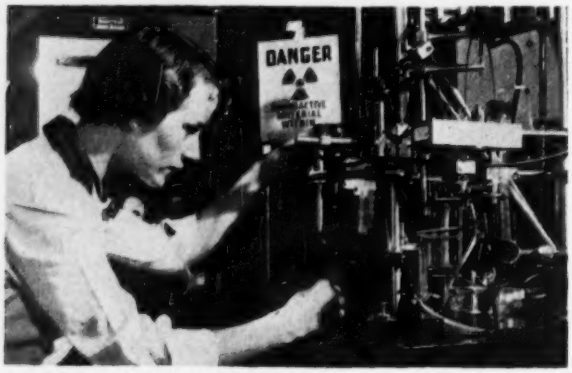
First in Controls

INSTRUMENTS ON THE MARCH

New Principles, Applications, Non-commercial Developments

Tracer Technique

UPTON, N. Y.—An electronic recorder (seen behind the laboratory technician's head) was developed by Minneapolis-



Honeywell to chart the path of isotopes through the bloodstream of guinea pigs at Brookhaven National Laboratory, Upton, N. Y. Biologists are conducting the research to learn more about the flow of blood in the capillaries.

Push-pull Transistors

CAMDEN, N. J.—Radio Corporation of America announces that n-p-n and p-n-p junction transistors now permit simplified "complementary symmetry" operation of circuits. When the same positive voltage is applied to both an n-p-n and p-n-p transistor, the current in one decreases while the current in the other increases. Hence two transistors in parallel produce the equivalent of push-pull operation without use of phase-splitting circuitry as is now required. Further economies in components can be effected in the output circuit because "complementary symmetry" operation obviates the need for a three-terminal output device, such as a push-pull output transformer.

Language Translator

NEW YORK, N. Y.—Russian has been translated into English by an electronic device for the first time. Thomas J. Watson, Board Chairman of the International Business Machines Corp., holds continuous sheet of English-worded sentences as they come from the printing mechanism of

the IBM "Type 701" Electronic Data Processing Machine at the company's New York headquarters recently. Fed into the "brain" are Russian messages recorded by holes punched in cards; they were processed electronically and turned up seconds later on the printer in English. Watching the first demonstration of its kind ever made are (left) Dr. Cuthbert C. Hurd, Director of IBM's Applied Science Division and Dr. Leon Dostert, Chairman of the Institute of Languages and Linguistics, Georgetown University, who originated the practical approach to the idea of electronic translation.

Michigan Symposium

ANN ARBOR, MICH.—The University of Michigan announces a Symposium on Instrumentation in Industrial Hygiene, May 24-27, 1954, co-sponsored by the Institute of Industrial Health and School of Public Health. Information can be obtained from Director, Continued Education, School of Public Health, University of Michigan, Ann Arbor, Mich.

Program: Sampling and analyzing air contaminants in work places, laboratory instruments for industrial hygiene, atmospheric pollution evaluation, measuring air velocity and metering air, measuring sound and vibration, measuring ionizing radiations, measuring ultraviolet and infrared energy, etc.

Small Linear Accelerators

MILWAUKEE, WIS.—A powerful new tool of nuclear research—Stanford University's billion-volt, super-high-frequency, 200-foot-long electron linear accelerator—is go-

ing to be made in junior sizes for cancer therapy and inspection of industrial products. The miniature accelerators will be manufactured and sold by the X-ray Department of General Electric Company under a 10-year agreement with the University. They should be on the market within the next few years.

Pressure Probe

LOS ANGELES, CALIF.—A tiny, total pressure probe, built on a Levin jewelers'-type lathe, from 0.072 and 0.018 tubing, to measure air flow through turbo-machinery, has been devised by AiResearch Mfg. Co. of Los Angeles.

Inserted into the small, high-speed machinery, the probe,

Users report on results with

Swartwout

AUTRONIC CONTROL SYSTEM

In just over 2 years since it was first introduced and caused such a sensation at the National Instrument Exhibit, Houston, the Autronic System has proven itself where proof counts—on stream—in plants in many parts of the country. For the Swartwout Autronic Control System is the *first system to control by all-electronic means—without boosters, slide wires or motors.* It senses . . . controls . . . indicates . . . records—faster and more accurately.

Reports like these keep coming in:

LARGE PROCESSING INSTALLATION—"In our plant, the Autronic Controller is located nearly a mile from the control valve. Its all-electronic operation has whipped the problem of process lags. And we're not troubled by leaking air lines. It has been in operation for one year and has been completely maintenance free."

PETROCHEMICAL PLANT—"Neatest, most compact installation on the graphic panel we've ever seen. Complete interchangeability of Autronic components without recalibration makes maintenance a cinch."

REFINERY—"We like the speed of response, reliability and general performance characteristics of our test installation. We figure on engineering the Autronic Control System into our new plant."

Call in our engineering representative to explain how the Swartwout Autronic Control System can bring new accuracy and speed to *your* process instrumentation and control. Or write today for literature on the *proven* Swartwout Autronic Control System.

A-8937

The following companies are representative of those who have purchased and who use Swartwout Autronic components:

American Cyanamid Company
Consolidated Chemical Industries Inc.
The Lummus Company
Minnesota Mining & Manufacturing Company
Sinclair Refining Company
Standard Oil Company (Indiana)
Universal Oil Products Company

Use of the above names is by permission but is not to be construed as constituting an unqualified endorsement.

Swartwout *Autronic* **CONTROL SYSTEM**

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12 • OHIO

For more information circle **15** on inquiry card.

If pyrometry plays a part in your business

THIS IS THE MOST HELPFUL BOOK YOU COULD HAVE IN YOUR FILES!

Here, in this well-indexed 56-page booklet is everything you want to know about thermocouples and pyrometers.

• **HELPS YOU SELECT THE RIGHT THERMOCOUPLE,** wire, and protecting tube for every installation. Complete information on all thermocouples and radiation pyrometers, with installation suggestions.

• **HELPS YOU KEEP THERMOCOUPLES ON THE JOB.** Complete, well-tabulated descriptions of replacement parts and accessories, with simple ordering instructions.

• **HELPS YOU GET QUICK, ACCURATE CALIBRATION DATA.** Calibration tables for all commonly used thermocouples, in Centigrade and Fahrenheit scales.

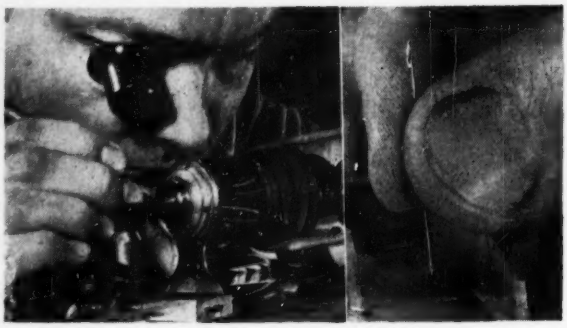
SEND FOR FREE COPY TODAY! Write The Bristol Company, 113 Bristol Road, Waterbury 20, Conn.

BRISTOL *THE DEPENDABLE GUIDEPOST OF INDUSTRY*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

For more information circle **16** on inquiry card.

ON THE MARCH—CONTINUED



a miniature reproduction of the common, larger external probes, measures total pressures within a cone of 100 degrees and at velocities reaching the speed of sound.

The probe had to be small enough to prevent disruption of the rapid flow of air through air ducts. A delicate forming tool on the Levin lathe cuts the proper angles in the .012-inch wall of the tube to form a Venturi section.

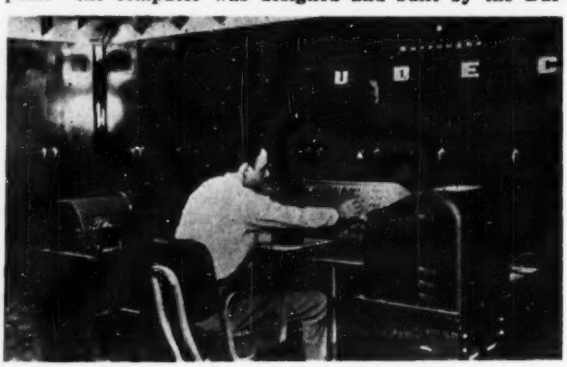
AiResearch has been able to find many precision uses for the Levin lathe—including lap-winding armatures for vibration pickup coils, shaping soapstone coil forms, and spinning silver tubing for thermocouple shields.

New Service

SAN CARLOS, CALIF.—A new service is available to Western firms using electronic equipment. Western Scientific Co. of San Carlos is under contract with several firms —including Ampex Corporation of Redwood City—to maintain and service the instruments used by the companies for quality control, testing, inspection, and measurements of all types. The service is said to be the first of its type, according to Jay Dobrin, Manager of Western.

"UDEC"

DETROIT, MICH.—A new giant computing machine was unveiled at Detroit's Wayne University in December. Known as "UDEC"—for Unitized Digital Electronic Computer—the computer was designed and built by the Bur-



roughs Corporation and installed in Wayne University's Computation Laboratory as part of a $500,000 community industrial education project instituted by Wayne and paid for by more than a score of Detroit's major industries. It is the second of its kind in the world. The only other similar machine is the original experimental model in Burroughs' Philadelphia Research Center.

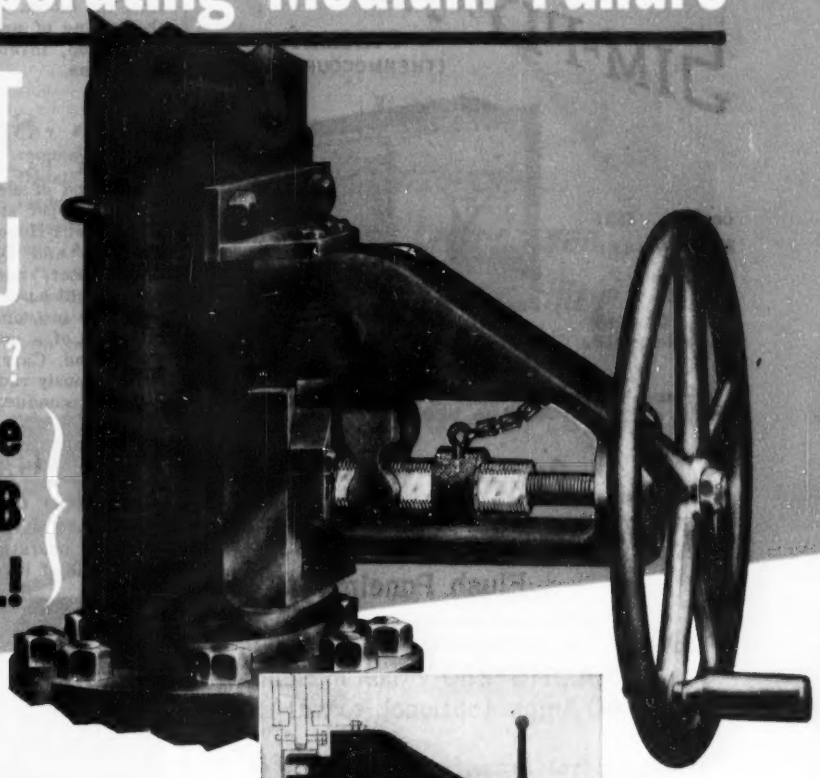
UDEC differs from other electronic computers because of its unitized construction.

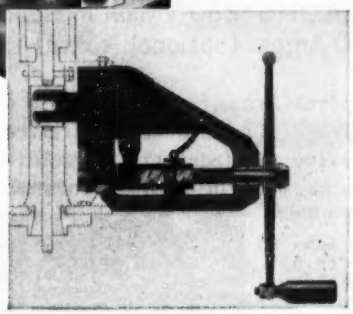
Primary purpose is to help train urgently needed personnel for operation of the country's growing number of electronic computers and to seek new developments in the field

Circle **17** on inquiry card.——→

Would an Operating Medium Failure SHUT YOU DOWN?

Not if you have this BS&B MANUAL CONTROL!





If the diaphragm control valves in your plant were suddenly rendered inoperative by failure of the operating medium, (or in rare instances by diaphragm failure within the valve), would you be forced to shut down immediately while repairs were made? Not if your valves are equipped with the BS&B Type Y Continuously Connected Side Handwheel for emergency manual control!

The Type Y is especially designed for use with all BS&B Diaphragm Control Valves, including Types 15 and 86, and the pressure balanced Type 73, where no by-pass is provided around the valve. It has a cast iron frame which fits onto the various Climax Valve Yokes. Working parts are of stainless steel, and it is equipped with an Ampcoloy jack screw, "Oilite" bearings and a large handwheel for ease of operation.

With the Type Y, control valves can be manually positioned in either direction independently of the normal controlling impulses. Its mechanism provides stops so that travel can be set to cover any portion of the complete valve stroke.

Avoid costly shut-downs due to operating medium or diaphragm failure! You can keep your plant operating indefinitely on an emergency basis if your control valves are equipped with the BS&B Type Y Continuously Connected Side Handwheel!

For complete information on any BS&B Climax Control or accessory, ask your BS&B Man, or write to . . .

CLIMAX BS&B CONTROLS OVER 60 YEARS

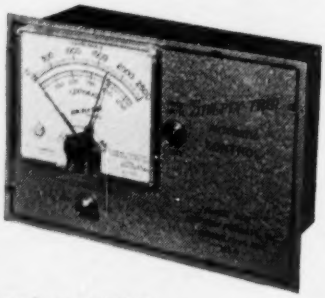
BLACK, SIVALLS & BRYSON, INC.
CLIMAX CONTROLS DIVISION, DEPT. 4-V2
7500 East 12th Street Kansas City 26, Missouri

For more information circle 17 on inquiry card.

AUTOMATIC—

SIM-PLY-TROL

PYROMETER
(THERMOCOUPLE TYPE)



Cat. No. 4531
Panelmount
0/2500° F.
0/1370° C.
$ 127.00 less thermocouple.

Other models from -400° to 3000° F.
(also Centigrade -240° to 1650° C.

Plug-In UNIT CONSTRUCTION

Wall Cabinet or
Flush Panelmount

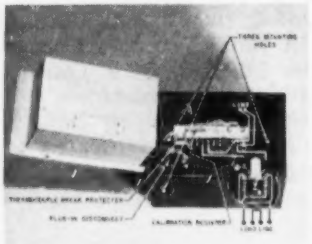
LOAD:
5 A., 115-230 V (non inductive)
40 Amps. (optional, extra)

The Simplytrol Automatic Pyrometer is a compact, on & off control or temperature shutoff device for industrial or laboratory furnaces, ovens or chemical processes.

Part of more than 60 Simplytrols in new plant of Precision Metalsmiths, Inc., 1081 East 200 Street Cleveland, Ohio.

This prominent manufacturer of precision investment castings by the lost wax process controls the heat of their gas fired furnaces with Simplytrols.

Order from this ad or
Send for Bulletin G-2
listing prices and ranges



Wall cabinet, (open) showing quick disconnect plug, terminal strip, T/C calibrating resistor and heavy duty relay, (optional).

Control unit is removable by taking out two screws and pulling quick disconnect plug.

Order from the nearest Simplytrol dealer

Assembly Products, Inc., Box 191, Chagrin Falls, O.
S. Sterling Co., 15310 W. McNichols, Detroit 35, Mich.
Electro-Tech, 308 Canal Street, New York 13, New York

For more information circle 18 on inquiry card.

ON THE MARCH—CONTINUED

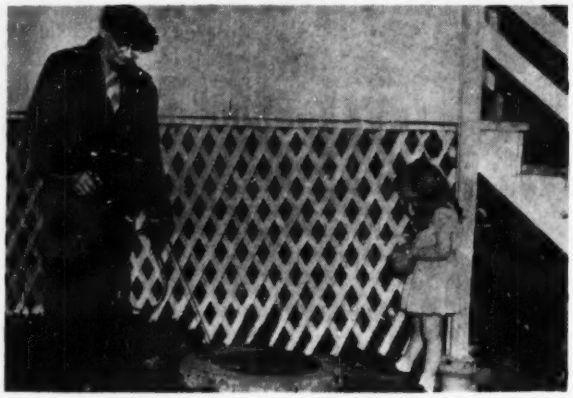
of automatic data processing equipment. In addition to this, the laboratory will be at the disposal of industry for the solving of practical problems in engineering, research, production, inventory control and certain other business operations.

Space Electricity

PHILA., PA.—A sensitive electronic device to probe the phenomena of electrical currents that exist between earth and the upper stratosphere was announced jointly by the Minneapolis-Honeywell Regulator Company and the Air Research and Development Command. The new "aerial electrometer," designed and developed by Minneapolis-Honeywell, will be carried aloft by balloons as high as 100,000 feet. The instrument will measure current as low as 1/10-millionth of a millionth of an ampere, or one million ions per second. Carried aloft by balloons, the instrument instantaneously radios back to a ground recording station the electrical conductivity, air temperature, and air pressure.

Gas Leak Locater

CHICAGO, ILL.—The Public Service Company Division of Commonwealth Edison Company takes no chances with the vital operation of investigating reports of gas leaks. Every one of its 225 service cars is equipped with a small



instrument that detects small concentrations of gas without reliance on the human senses.

Serving some 420,000 residential, commercial and industrial customers in a large area of northern Illinois, Public Service Company crews respond to gas leak complaints quickly. If the source of the escaping gas cannot be identified by smell or customary "soapsuds" method, the serviceman uses his "Explosimeter." A development of Mine Safety Appliances Company, Pittsburgh, the portable "Explosimeter" detects gas leaks in a variety of locations and under many types of conditions.

Shop Kink

Don't throw away the dials from discarded pressure gages. These dials, in various ranges and sizes, can be put to good use in your instrument shop. Cut out the center of the dial, leaving only enough of the rim to show the graduations. When checking a gage the regular dial is removed. The "skeleton" dial is then placed on the gage. Its shape allows free access to the movement and all adjustments. (*Submitted by E. L. Burner, Morgantown, W. Va.*)

SANBORN 150 SERIES
OSCILLOGRAPHIC RECORDERS

The BASIC four-channel assembly includes: Cabinet, Recorder, and, for each channel, a BUILT-IN unit (A), which comprises a Driver Amplifier with frame, and a Power Supply with control panel.

A NEW design concept that brings even greater versatility to industrial OSCILLOGRAPHIC RECORDING

You have a CHOICE of readily interchangeable, plug-in Preamplifiers (B) for EACH channel, as described below.

The new Sanborn 150 Series offers greater operating efficiency and convenience, and encompasses a *variety of uses* which include the accurate recording of almost every phenomenon whose frequency spectrum lies in the range from 0 to 100 cycles per second.

A *wide selection* of plug-in preamplifiers, or "front end" units, such as (B) above, are completely interchangeable in any or all channels of the 150 Series amplifier section, where they simply plug in to the driver amplifier and power supply, (A) above, which are already in place.

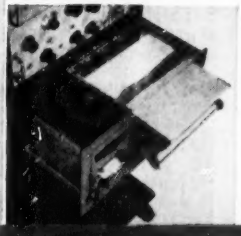
Available plug-in Preamplifiers include: AC-DC, CARRIER, SERVO-MONITOR, DC COUPLING, LOG-AUDIO, and LOW LEVEL. Blank plug-in assemblies are also available for users to make input circuits for special measurement problems.

And, there are the popular Sanborn advantages: a high torque movement (200,000 dyne cms per cm deflection), direct *inkless* recording in *true rectangular coordinates*, and provision for code and time markings.

A new catalog on Sanborn Oscillographic Recording Systems and their components will be sent gladly on request.

OTHER SANBORN IMPROVEMENTS

- **Extended frequency response.**
- **Improved regulated power supply.**
- **Individual stylus temperature control for EACH channel.**
- **Improved, single control, paper speed selector. Nine speeds — 0.25 to 100 mm/sec.**
- **Recorder slides out, if desired, for better view of recorded events, or for notations on record (illustrated at right).**
- **Improved control of input signals by use of 1, 2, 5 ratios on attenuator.**



Be sure to see the 150 Series at BOOTHS 455–457, I.R.E. Convention, Kingsbridge Armory, Bronx, N. Y. March 22–25, 1954.

SANBORN COMPANY
INDUSTRIAL DIVISION

195 MASSACHUSETTS AVENUE
CAMBRIDGE 39, MASS.

For more information circle **19** on inquiry card.

SHADOGRAPH . . . for Fast, Precision Weighing

SHADOGRAPH'S shadow-edge indication is projected by a beam of light, eliminating all friction of indicating mechanism and increasing visible accuracy over 300%. Greater speed is achieved through reduction of lever movement and by the action of an adjustable damping device. Accurate reading can be made from any angle without danger of parallax. Ideal for precise compounding, for weighing very costly materials, or for dozens of other uses calling for extreme accuracy. Available in capacities from 50 grams to 25 pounds; sensitivity as fine as 12 milligrams. Send coupon today!

Exact Weight Scales

Better quality control
Better cost control

THE EXACT WEIGHT SCALE COMPANY

951 W. Fifth Avenue, Columbus 8, Ohio
2920 Bloor St., W., Toronto 18, Canada

Please send details on SHADOGRAPH

☐ Literature only ☐ Have representative call

Name .....

Address .....

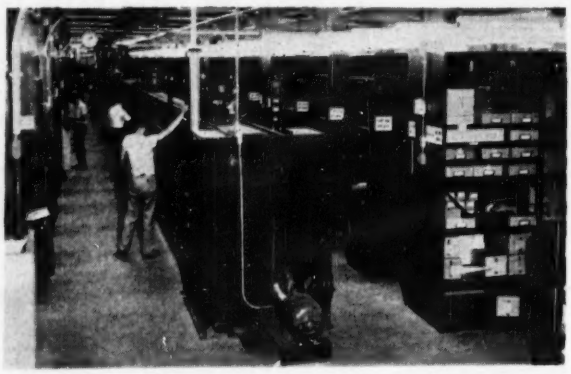
City ..... Zone ..... State .....

For more information circle **20** on inquiry card.

ON THE MARCH—CONTINUED

Materials Handling

CHICAGO, ILL.—Allied Radio Corp. of Chicago, large electronic-component and instrument distributor, uses conveyors and pneumatic tubes to fill orders, including a 5-



tier conveyor belt with 1,500 total linear feet. There are separate local and express belts for the salesrooms and local and express belts for the shipping department. The fifth belt is for returning pans.

The pneumatic-tube system consists of 7,200 feet of tubing for routing orders from the Telephone Order, Mail Order, and City Sales sections to various sections on the stock floor.

Tungsten Resistance Thermometers

NEW YORK, N. Y.—General Electric engineers have revealed the first successful use of tungsten in a commercial precision resistance thermometer. The tungsten resistance thermometer is said to be "first successful one with stabilities as good as, or better, than platinum."

Tungsten offers advantages as resistance thermometer: high melting point (3380 C.) and large change in resistance with temperature. It is also readily available from the manufacturers of electric light bulbs, in the form of high purity ductile wire.

The inherent temperature limitations of the commonly used metals such as copper, platinum, nickel, etc., are well known. The best of these materials, platinum, has an upper range of approximately 600 C. However, experiments conducted with tungsten show excellent stability at temperatures up to 1000 C.

Torque Tests

TOLEDO, OHIO.—The Toledo plant of the National Supply Company uses Baldwin torquemeters on the driving shaft (left) and driven shaft (right) of a torque converter, which is in a transparent enclosure. A 250-hp. diesel en-

measure records faster...

with the low-cost Contact Telereader System

The problems of manual measurement—slowness, inaccuracy and high labor cost—are solved by the Contact Telereader System.

It measures oscillograph, seismic and other graphic records, makes up to 40 measurements per minute and provides .01" accuracy.

Flexibility is a major advantage of the system. It handles single sheet or roll records of any length, any width up to 18", performs linear and non-linear calibrations, reads out in typewritten reports, punched cards, or perforated tape. The Contact Telereader can also be used alone for high-speed measuring with manual readout.

Operation: The operator makes measurements by rapid X-Y cross-wire motion. The measurements are then electronically converted into digital form for readout to an electric typewriter, tape perforator, summary punch or key punch. Measuring and readout are almost simultaneous.

Please send requests for specifications to Preston W. Simms, Dept. I-2.

TELECOMPUTING CORPORATION

BURBANK, CALIFORNIA • Washington, D. C.

For more information circle **21** on inquiry card.

YOUR POTENTIOMETRIC INSTRUMENTS

NO matter how perfect otherwise, the human organism isn't much good without a dependable heart. The same is true of your automatic temperature and pH control instruments.

The "heart" of most such instruments for the past quarter century has been the Eplab Standard Cell. It is a "yardstick" for translation of voltage to temperature or pH. The first American commercial cell of its type, constantly improved by research, it is "as standard as sterling".

Get ACCURATE temperature or pH control with potentiometers and make sure the standard cells are EPLAB.

The Eppley Laboratory, Inc. 2 Sheffield Ave., Newport, R. I.

EPLAB *Standard* CELLS
FOR POTENTIOMETRIC INSTRUMENTS
As Standard as Sterling

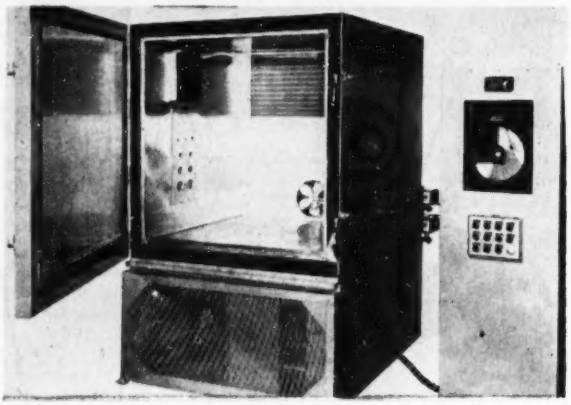
For more information circle **22** on inquiry card.

ON THE MARCH—CONTINUED

gine drives the converter pump through an SR-4 torque pick-up of 12,000-in.-lb. capacity. The output shaft drives an eddy-current brake through a 30,000-in.-lb. torque pick-up. Test values of hydraulic thrusts parallel with the shaft were measured by means of an SR-4 load cell enclosed below the driven end of the shaft and activated by two vertical levers, one of which can be seen there. Another SR-4 load cell was placed on the driving end with a lever system to measure the torque of the reaction member of the converter. During tests the operator uses the engine throttle in his right hand and other instrumentation, including tachometers, oil pressure gages, and control equipment.

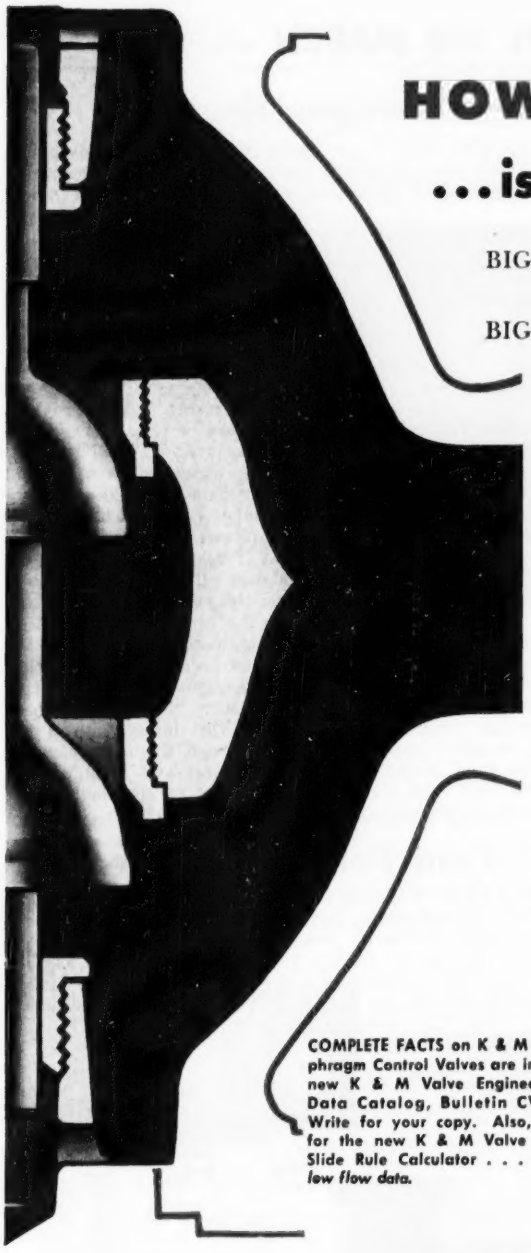
Test Chamber

BRISTOL, CONN.—American Research Corporation of Bristol has shipped the first of several test facilities to the Canadian Government—a humidity simulation chamber. A special feature of this cabinet is that in addition to reproducing relative humidity from 20 to 100 percent, it will also simulate rain fall at 4 inches per hour. All test factors are operated automatically on a programmed cycle.



Large Butterfly Valve

FAIRFIELD, CONN.—One of the largest butterfly valves ever built for handling air is being installed in a wind tunnel of one of the government's aeronautic laboratories. The valve, designed and constructed by W. S. Rockwell Company, Fairfield, has 96-inch inside diameter. The assembled valve weighs 7.5 tons. The blade is actuated by a large hydraulic cylinder, 10-in. bore, 51-in. stroke, with oil at 1000 psi. as the power medium. A power unit of this size is capable of developing a theoretical torque of 3,300,000 inch-pounds.



HOW BIG

...is a K & M six-inch valve?

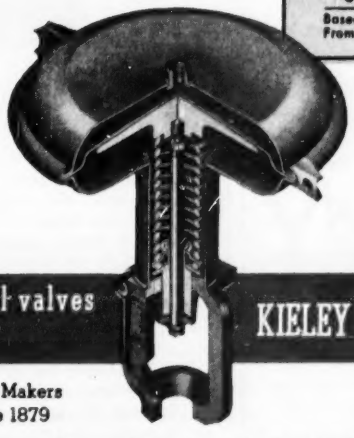
BIG enough to pass 500 gpm of cold water through the valve body at a constant drop of one pound pressure. BIG enough to provide the largest flow coefficient available in a standard six-inch diaphragm control valve. Body flow passages of all K & M valves, for example, actually average 140% of cross-sectional pipe area. There's more space for fluid to flow . . . smoothly, freely and without turbulence. Frequently a smaller nominal size K & M Valve provides sufficient capacity to satisfy requirements that formerly called for a larger, more expensive valve. Inner valve open areas, on the other hand, average only 80% of cross-sectional pipe area. Therefore, flow restrictions occur principally across the inner valve . . . where the restriction is controllable throughout the entire range of valve stem travel. This K & M design often permits lower initial costs . . . always contributes to more precise flow regulation through the K & M Inner Valve.

COMPLETE FACTS on K & M Diaphragm Control Valves are in the new K & M Valve Engineering Data Catalog, Bulletin CV53. Write for your copy. Also, ask for the new K & M Valve Size Slide Rule Calculator . . . with *low flow data.*

C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
¾"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.



diaphragm control valves

K&M

Valve Makers Since 1879

KIELEY & MUELLER, INC.

64 Genung Street
Middletown, New York

For more information circle **23** on inquiry card.

ATLAS

TEMPERATURE REGULATORS are made for EVERY SERVICE

Your temperature regulating problems, no matter how tough, can be handled by ATLAS Engineers. You can place your problems in their hands with confidence because the making of regulating valves has been our ONLY business for more than a half century.

For example, every American is proud of the achievements of the new ocean liner —the

S.S. UNITED STATES

On page 144 of the Sept. 1952 issue of MARINE ENGINEERING & SHIPPING REVIEW you will find that ATLAS is credited with furnishing: "Valves, regulators and strainers (composition reducing valves, composition pressure reducing valves, combined pressure and temperature regulators, composition strainers)"—all on the S.S. United States.

Where Are They Used?

ATLAS Temperature Regulators are used to control the temperature of water, fuel oil, and other liquids in all kinds of open and closed tanks and heaters which are heated by steam or gas. Those listed below are completely described in our Bulletins No. 6-A and 7-A. Ask for a copy of each.

No. 650. Balanced Type Double Seat Valve, Spring Adjustment. Sizes ½" to 6" inclusive.
Nos. 651 and 653. Needle Type Single Seat Valve. Spring Adjustment. Sizes ½" to 1½" inclusive.
No. 655. Balanced Type Double Seat Valve, Lever and Weight Adjustment. Sizes ½" to 6" inclusive.
Nos. 660 and 662. Single Seat, Self-Contained, Pilot Operated for High Pressure Steam. Sizes ½" to 4" inclusive.
Nos. 112-651 and 112-653. Combination Temperature and Pressure Regulator. Sizes ½" to 4" inclusive.
No. 651-ES Combination Temperature and Pressure Regulator. Sizes ½" to 2" inclusive.
No. 6 Thermostat, Pneumatically Operated.
No. 12 Thermostat, Hydraulically Operated.

See list of the principal ATLAS products below.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

292 South Street **Newark 5, New Jersey**

Represented in Principal Cities

Campbell Boiler Feed Regulator	Pump Governors
Temperature Regulators	Damper Regulators
Reducing Valves	Back Pressure Valves
Exhaust Control System	Balanced Valves
Pressure Regulators	Control Valves
	Float Valves

For more information circle **24** on inquiry card.

ON THE MARCH —CONTINUED

Oxygen Monitor

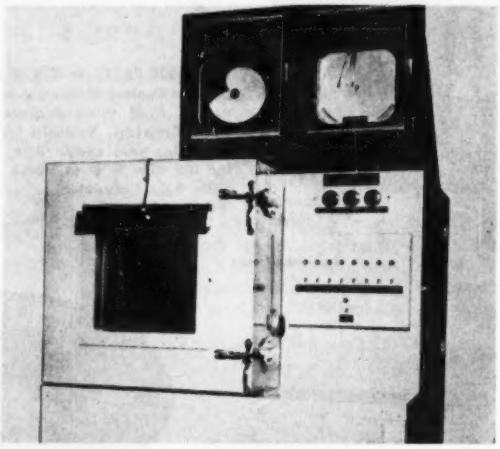
PITTSBURGH, PA.—Westinghouse Electric equipment engineers have developed their own method of employing inert gases in the processing of asphalt—or the newer Thermalastic-insulation-type high-voltage stator coils, which are susceptible to ionization in high-voltage service.

Westinghouse engineers found an inert atmosphere must be maintained in the impregnating tanks above the level of the asphaltic gum or newer copolymer resins. This is provided for by use of pure nitrogen, as manufactured by the "Exogas" system, which burns a natural gas-air mixture; the products of combustion consist primarily of nitrogen.

As it is necessary to guarantee that all oxygen is removed from the atmosphere in contact with the impregnants, an MSA Oxygen Indicator continuously indicates and records the percentage of oxygen from various sample points within the impregnating tanks and the gas-generating and processing units. Representatives of Mine Safety Appliances Company, Pittsburgh, report that this installation is the first recorded use of its kind, although the instrument is widely used in the petroleum, chemical and metallurgical industries for continuous measurement of oxygen in inert or combustible atmospheres.

Cam Follower Problem

NEWARK, N. J.—A control problem on a Tenney test chamber manufactured for Remington Rand of Shreveport was recently solved by Tenney Engineering of Newark in a way that can be applied to similar problems. Chamber

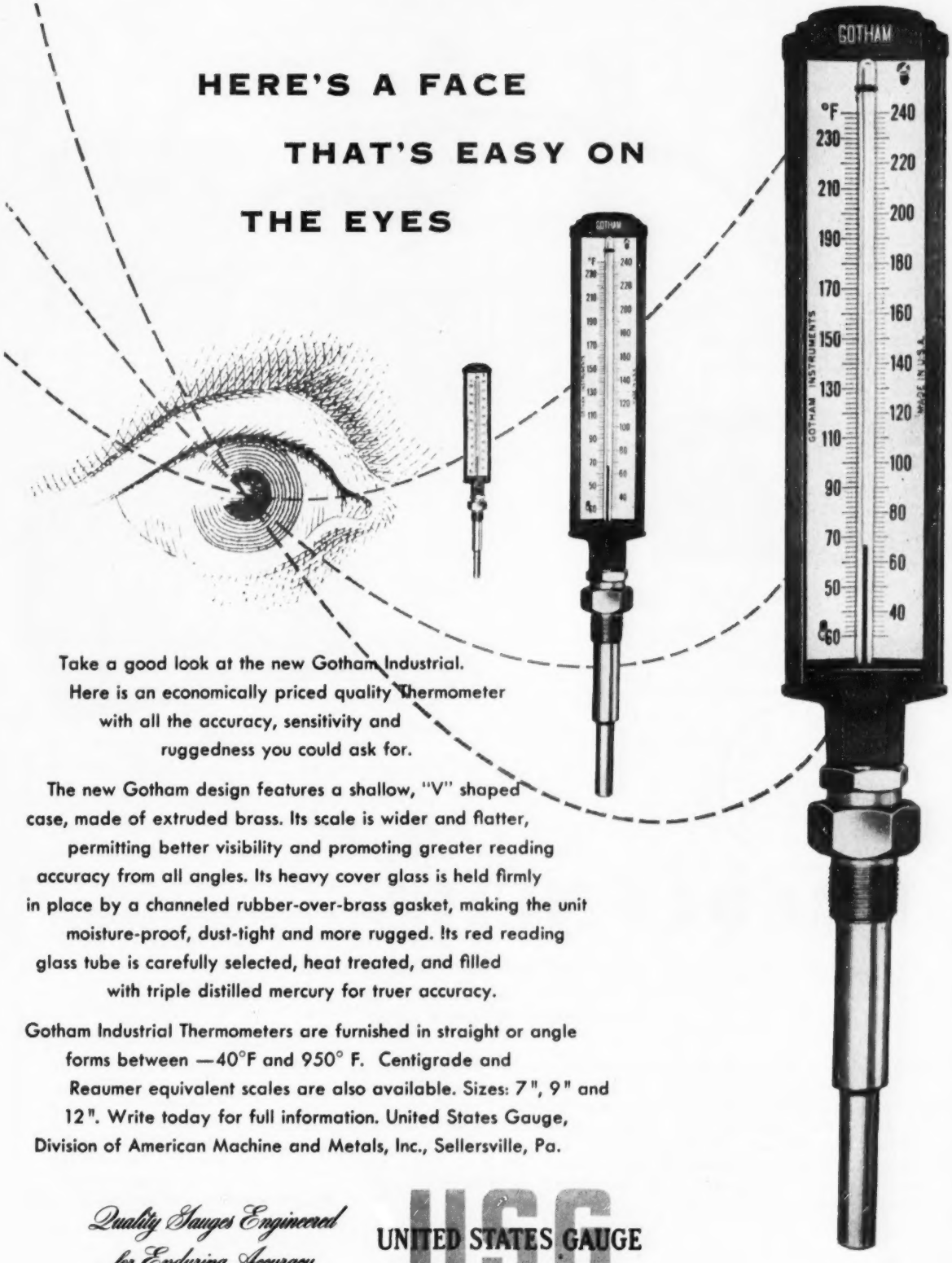


temperature was controlled by a Bristol cam and follower arrangement. However, the time available for changing temperatures was too short for one specification because the cam follower could not ascend a cam cut at an angle greater than 60 degrees.

The problem was solved by designing the cam as an 8-hr. cam; the recorder chart remains a 24-hr. unit. The faster-moving cam requires a less-steep ascent which the follower could handle. The special instrumentation is shown.

The relatively rapid chamber expansions and contractions caused by rise and pull-down of temperatures necessitated special care in vapor sealing; the stainless-steel panels were set in mastic and the joints covered with lead tape.

HERE'S A FACE THAT'S EASY ON THE EYES



Take a good look at the new Gotham Industrial. Here is an economically priced quality thermometer with all the accuracy, sensitivity and ruggedness you could ask for.

The new Gotham design features a shallow, "V" shaped case, made of extruded brass. Its scale is wider and flatter, permitting better visibility and promoting greater reading accuracy from all angles. Its heavy cover glass is held firmly in place by a channeled rubber-over-brass gasket, making the unit moisture-proof, dust-tight and more rugged. Its red reading glass tube is carefully selected, heat treated, and filled with triple distilled mercury for truer accuracy.

Gotham Industrial Thermometers are furnished in straight or angle forms between —40°F and 950° F. Centigrade and Reaumer equivalent scales are also available. Sizes: 7", 9" and 12". Write today for full information. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pa.

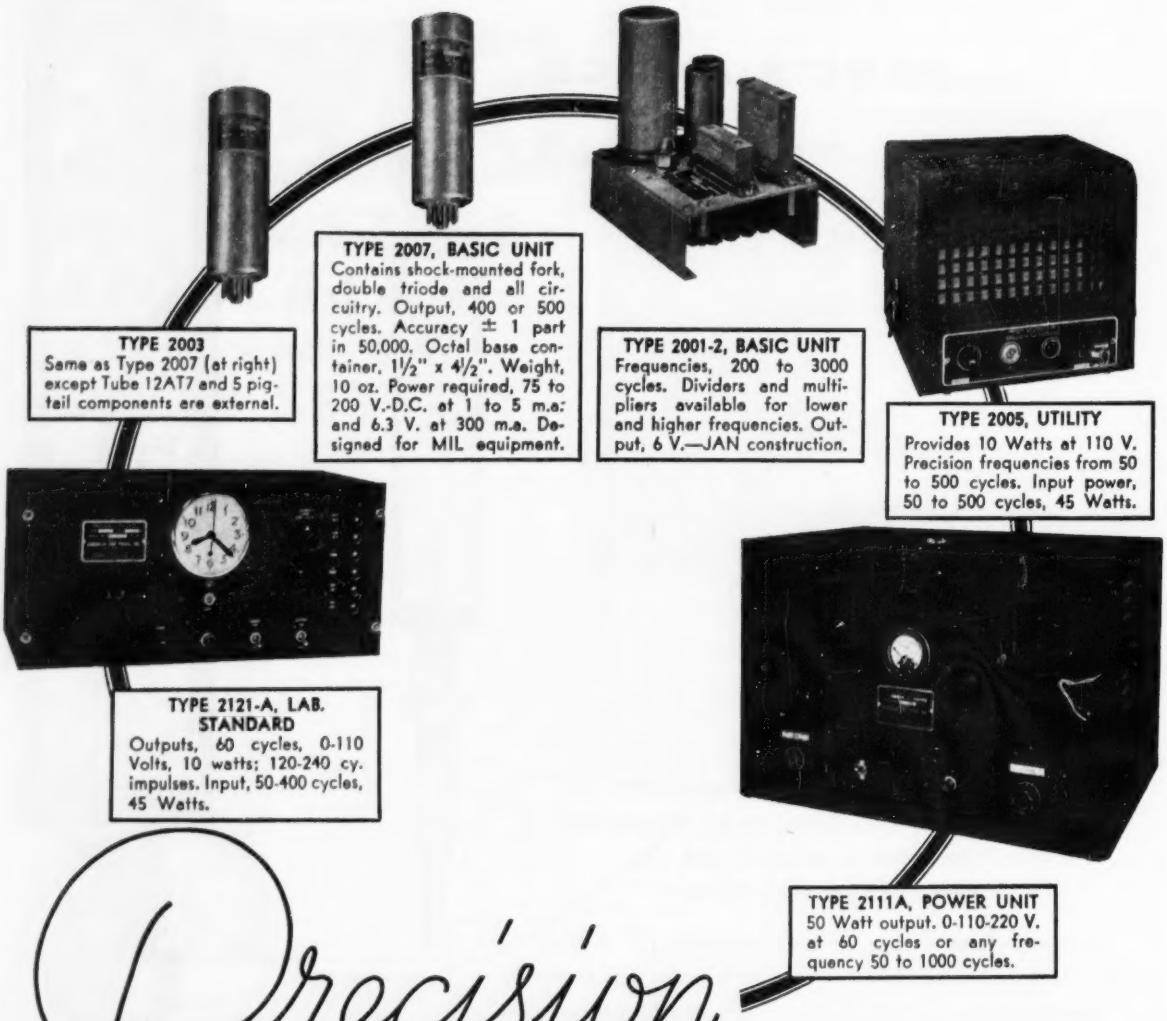
Quality Gauges Engineered for Enduring Accuracy

USG UNITED STATES GAUGE

PRODUCTS OF UNITED STATES GAUGE... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • AltitudeGauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS

For more information circle **25** on inquiry card.



TYPE 2003
Same as Type 2007 (at right) except Tube 12AT7 and 5 pigtail components are external.

TYPE 2007, BASIC UNIT
Contains shock-mounted fork, double triode and all circuitry. Output, 400 or 500 cycles. Accuracy ± 1 part in 50,000. Octal base container, 1½" x 4½". Weight, 10 oz. Power required, 75 to 200 V.-D.C. at 1 to 5 m.a. and 6.3 V. at 300 m.a. Designed for MIL equipment.

TYPE 2001-2, BASIC UNIT
Frequencies, 200 to 3000 cycles. Dividers and multipliers available for lower and higher frequencies. Output, 6 V.—JAN construction.

TYPE 2005, UTILITY
Provides 10 Watts at 110 V. Precision frequencies from 50 to 500 cycles. Input power, 50 to 500 cycles, 45 Watts.

TYPE 2121-A, LAB. STANDARD
Outputs, 60 cycles, 0-110 Volts, 10 watts; 120-240 cy. impulses. Input, 50-400 cycles, 45 Watts.

TYPE 2111A, POWER UNIT
50 Watt output. 0-110-220 V. at 60 cycles or any frequency 50 to 1000 cycles.

Precision FREQUENCIES

GUARANTEED ACCURACY
1 PART IN 100,000 (.001%)
except where otherwise noted

The basis of these frequency standards is an electronically actuated high-precision fork, temperature-compensated and hermetically sealed against barometric changes. The partial list of uses at the right not only suggests the broad range of applications but also proven dependability where there can be no compromise with accuracy. Please request details by Type No. Our engineers are available for advice or cooperation on related problems.

WIDELY USED IN SUCH FIELDS AS
Aviation, Navigation
Ordnance, Ballistics
High Speed Photography
Viscosity Measurement
Fluid Flow
Nuclear Physics, Telemetering
Chemical Reaction
Radiation Counting
Computers
Facsimile
Fire Control
School and Indl. Research Labs.
Accurate Speed Control

American Time Products, Inc.

580 Fifth Avenue ***New York 36, N. Y.***

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

For more information circle **26** on inquiry card.

DEKORON INSTRUMENT TUBING

knocks out your instrument line corrosion problems

DEKORON single-line tubing. Samuel Moore & Co. will coat your copper, aluminum or steel tubing by the Dekoron extrusion process, or will supply coated tubing. Straight lengths to 20 ft., coils to 1000 ft.

DEKORON IMPERVAPAK is a multiple tube harness of plastic or metal tubes encased in tight plastic sheath. Multiple tube construction cuts down installation costs.

Corrosion endangers the life line of your plant—your instrument tubing. That's why you should investigate Dekoron instrument tubing, the tubing that's impervious to moisture, salt air, corrosive atmospheres, and chemicals.

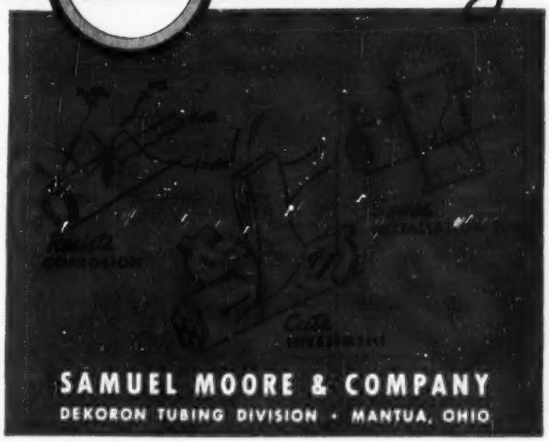
That means Dekoron eliminates replacement costs and maintenance. Other advantages are low initial cost . . . less plant down time . . . easy installation with standard fittings and plastic tape.

In replacement savings alone—not including lower maintenance and installation costs—Dekoron Instrument Tubing pays for itself over and over again.

A-7834

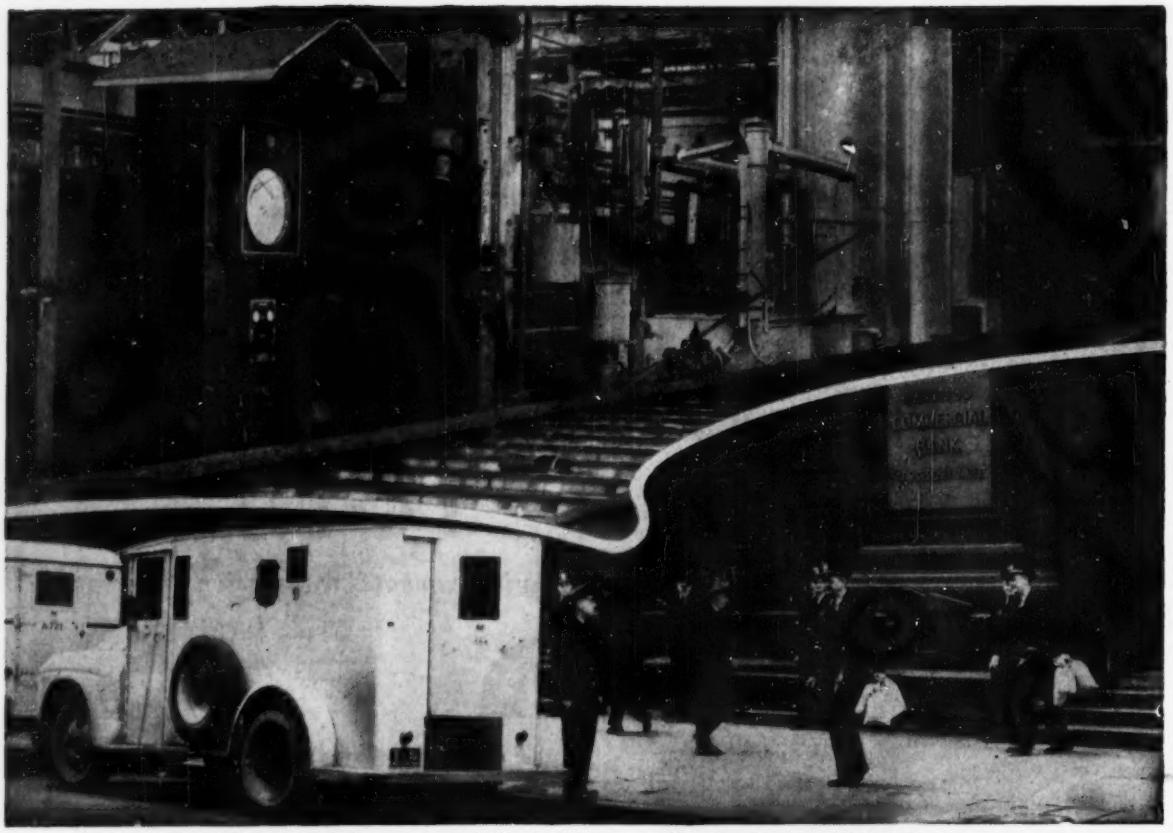
Send for free copy of Bulletin L-6506 "3 Ways to Whip Corrosion and High Tubing Installation Costs in Your Plant."

Dekoron® tubing



SAMUEL MOORE & COMPANY
DEKORON TUBING DIVISION • MANTUA, OHIO

For more information circle **27** on inquiry card.



Modern Safeguards—Brink's for Money, Bailey for Process Materials

Are Your Process Materials Guarded As Well?

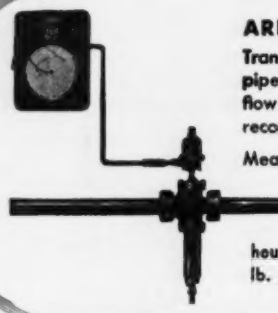
HERE'S HOW TO PREVENT SPOILAGE AND WASTE . . .

TO avoid waste of valuable process materials and finished products, process rates and conditions must be accurately measured and controlled. That's where Bailey Meters, Analyzers and Controllers can help you to improve the efficiency of your plant.

Take flow for instance. Bailey Meter Company offers a complete line of flow measuring and controlling equipment for applications ranging all the way from high pressure steam to low pressure gas. We measure flow in pipes, open channels, ducts, furnaces, smelters, kilns, ovens, dryers.

When you call Bailey Meter Company, you get the help of years of experience as well as recommendations from a wide selection of measuring and controlling devices.

Your local Bailey Engineer is as near as your telephone. He has the experience and the equipment necessary to set up an effective guard for your process materials.



AREA TYPE FLOW METER

Transmitter goes into 1, 2 or 4 inch pipe line like a valve and transmits flow measurements electrically to recorder in remote location.

Measures oil and other clear liquids under static pressures up to 600 psi. Minimum range 0 to 1200 lb. per hour, maximum range 0 to 96,000 lb. per hour.

BAILEY METER COMPANY

1041 IVANHOE ROAD
CLEVELAND 10, OHIO

Process Controls
TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO

For more information circle **28** on inquiry card.

how to SOLVE your LOW-CAPACITY FLOW CONTROL problems

Q. What are Controlled Volume Pumps?

A. Reciprocating, positive displacement, flow control instruments, driven by air or electric motor. They pump with a repetitive accuracy of plus or minus one percent. Capacities from 3 milliliters per hour to 45 gallons per minute . . . Pressures to 25,000 pounds per square inch. Capacity adjustment—manual . . . or automatic response to a control signal from an electronic or pneumatic control instrument.

Q. Where are Controlled Volume Pumps Used?

A. Across all industry . . . for flow control and pumping of precise quantities of chemicals and slurries . . . for accurate ratioing of chemical streams . . . and for automatic control of a process variable, such as pH, using these pumps as final control elements.

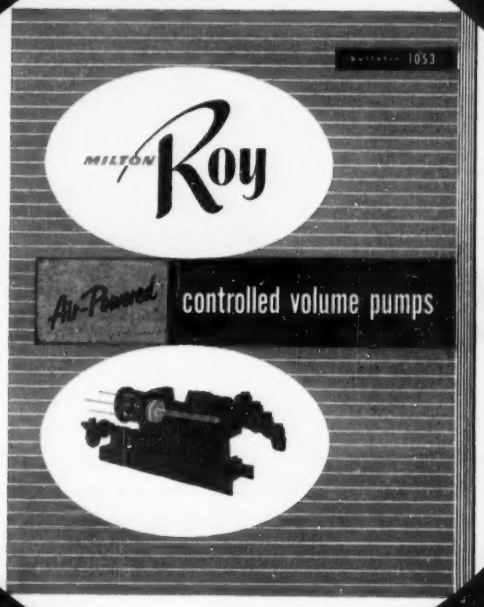
Q. What is the Milton Roy Exclusive Step-Valve Liquid End?

A. A patented step-valve liquid end with individually inspectable ball checks (to facilitate cleaning). Sloping passages purge entrained air, assuring high repetitive volumetric efficiency.

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

This new 16-page Bulletin 1053 on Air-Powered Controlled Volume Pumps is your guide to precise flow rate control of low-capacity chemical and slurry streams. It contains a graphic presentation of pump operating principles; capacity-pressure and air-consumption tables; examples of complete Milton Roy engineered chemical feed systems, using these instruments.

Solve *your* low-capacity flow control problems. Send for your copy of Bulletin 1053, *now*.



CONTROLLED VOLUME PUMPS ARE FLOW CONTROL INSTRUMENTS

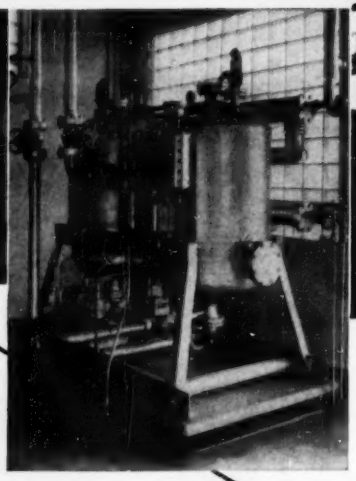
MILTON Roy COMPANY

Manufacturing Engineers • [illegible]KMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

For more information circle **29** on inquiry card.

Lectrodryer* feeds the nerve center DRY AIR only!



Type BY-5 Lectrodryer provides continuous flow of dried air to panels in control room, protecting vital control instruments and lines against moisture. →

Automatically controlled McMurrey Refinery near Tyler, Texas. One operator in the control room can control and watch over its entire operation.

2300 instruments . . . 900 controllers and valves depend on DRY air to put this giant through its paces automatically. If unwanted moisture were to creep into instrument air at the nerve center, the refinery could be thrown haywire! An instrument line freeze-up, rust, scale or sludge clogging tiny ports could cause a long shutdown.

For 24 hours a day a Lectrodryer feeds the nerve center a constant stream of air dried to a dewpoint of -50° F. Moisture doesn't have a chance!

Lectrodryers catch the moisture which separators and filters let by. Throughout the chemical and petroleum industries they dry air, gases and organic liquids . . . automatically, economically, continuously. For extreme dryness there are Lectrodryers drying down to 3 to 4 parts per million or less.

Whatever the drying need, there's probably a Lectrodryer already built to handle it. Our engineers will help you lay out your system and select proper equipment. Write: Pittsburgh Lectrodryer Corporation, 330 32nd Street, Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Beige Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

For more information circle **30** on inquiry card.

CHIEF ENGINEER WILLIAM NOTE inspects the original Leslie Temperature Pilot taken from heater for its first overhaul. Leslie Representatives Frank Riggio (*left*) and Bob Gentner (*right*) look on.

DEWITT O. HESSLER, Laundry's President, joins Chief Note in examination of the original Leslie Pilot before reinstallation.

HOW SHOULD A 21-YEAR-OLD BEHAVE?

Temperature Pilot leads flawless life for 21 years prior to its recent, initial overhaul

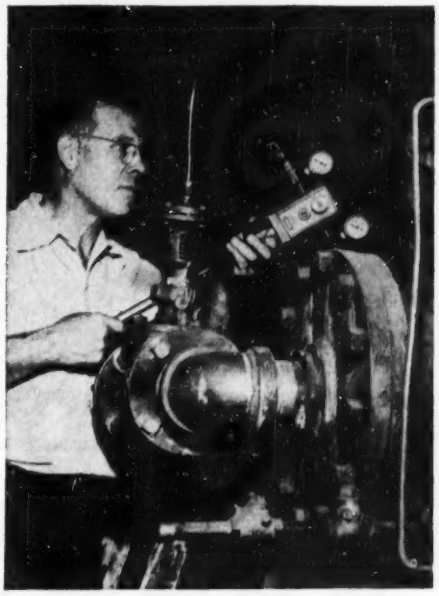
A 21-year-old Leslie Temperature Control Pilot had its "coming-out-party" recently at the Hessler Laundry, Paterson, N. J. The very first one of its kind ever made, it was installed at the Hessler plant back in 1933 by the firm's chief engineer, Bill Note—who also ordered the pilot's first overhaul in 21 years of continuous service.

The pilot was designed to control constant process temperature over extended periods without necessity for recalibration or replacement of thermal elements. The Hessler field test worked out so well that the pilot was left untouched after its initial setting, for 21 years.

Periodic inspections showed the pilot was doing the job without appreciable wear or need for *any* attention. This year, it was removed from the heater for a complete examination and after a quick clean-up, it was put right back into service.

Top performance suggests other applications

The outstanding behavior of this first pilot is being repeated today by Leslie Pilots in hundreds of other applications in all industries. The wide adjustable ranges (32°-400°F and 300°-600°F) make the pilots adaptable to most operating conditions. The fast-responding bi-metallic element responds to changes as small as ¼°F.



CHIEF NOTE REINSTALLS PILOT after *no-cost* overhaul. Parts showed no appreciable wear or corrosion after 21 years of continuous hot water heater service.

Send for Technical Data Sheet 464-14 describing Leslie Temperature Pilots and Controllers.

TRADE LESLIE MARK

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

LESLIE CO. 299 **Grant Avenue, Lyndhurst, New Jersey**

For more information circle **31** on inquiry card.

Added Evidence that—

Everyone Can Count on VEEDER-ROOT

REPORTER AT LARGE . . . that's what you might call this new Veeder-Root Reset Magnetic Counter . . . adaptable to remote counting from machines or processes to central boards or instrument-clusters, wherever you want to put them. NOW . . . what can your imagination do with these few facts? For the *full facts*, write:

VEEDER-ROOT INCORPORATED
"The Name That Counts"
HARTFORD 2, CONNECTICUT
Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada • Dundee, Scotland
Offices and Agents in Principal Cities

"Counts Everything on Earth"

For more information circle **32** on inquiry card.

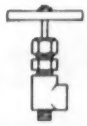
HOW TO SOLVE THE *tough* NEEDLE VALVE PROBLEMS

UNION BONNET
ANGLE PATTERN
(Female Ends)

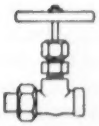
SCREWED BONNET
STRAIGHT PATTERN
(Female Ends)

SCREWED BONNET
ANGLE PATTERN
(Female Ends)

SCREWED BONNET
STRAIGHT PATTERN
(Male End)



SCREWED BONNET
ANGLE PATTERN
(Male End)



SCREWED BONNET
STRAIGHT PATTERN
(Union End)

Teflon-packed American Needle Valves "lick" the really tough meter manifold jobs — sour gas, wet gas, odorizing, chemical plant and refinery applications and other difficult and corrosive field services.

Precision machined valve bodies (stainless or carbon steel) are specially suited for welding. Stainless steel valve stems, centerless-ground for exact fit, are designed so that the valves can be repacked under pressure. Positively aligned valve seats are burnished for point-contact seating.

Every valve is hydrostatically tested. Standard valves are designrated for 5000 psi working pressure at 70°F. Valves are also available for higher pressures to 10,000 psi and can be furnished, with graphite impregnated asbestos packing, for temperatures above 450°F.

Write for Complete Specifications.

***In actual tests, Teflon packing prevented gland leakage through 124,000 on-and off cycles, without tightening the packing nut.**

AMERICAN® METER COMPANY
INCORPORATED ESTABLISHED 1874

AMERICAN METER CO EST 1874

GENERAL SALES OFFICE: 1513 Race Street, Philadelphia
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Kansas City • Los Angeles • Minneapolis • New York
Omaha • Pittsburgh • San Francisco • Seattle • Tulsa
IN CANADA: Canadian Meter Company, Limited
Hamilton, Ontario • Edmonton, Alberta

For more information circle **33** on inquiry card.

Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters

Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

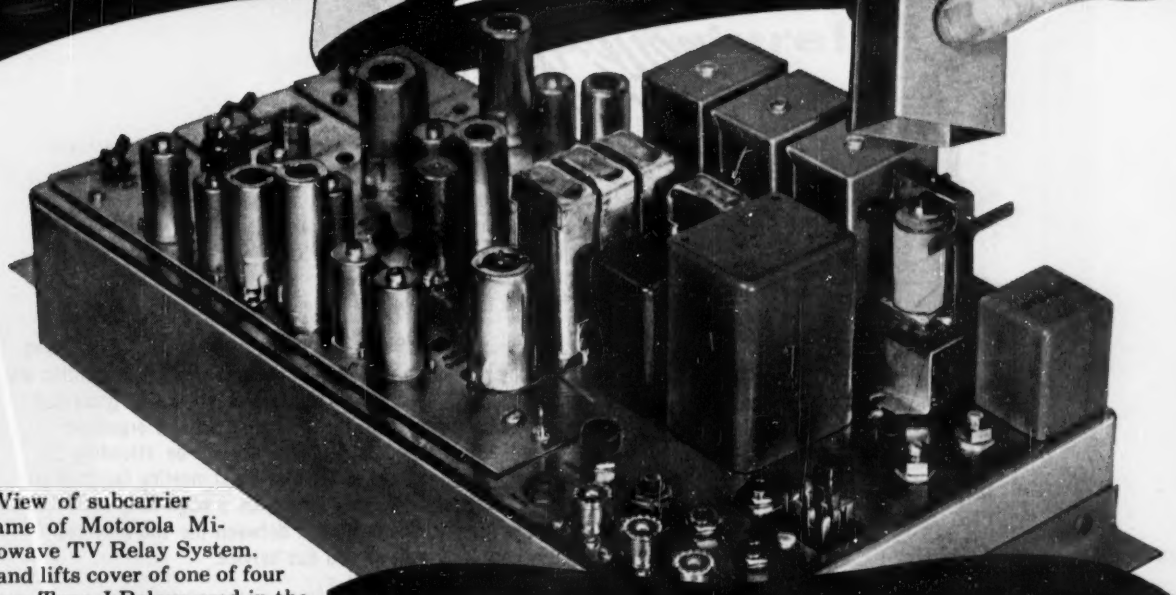
- No oil filters.
- No dust filters.
- No internal lubrication to contaminate air handled.
- No internal wearing parts.
- No valves, pistons, or vanes.
- Non-pulsating pressure.
- Original performance constant over a long pump life.
- Low maintenance cost.

NASH ENGINEERING COMPANY
370 WILSON, SO. NORWALK, CONN.

Circle 34 on inquiry card. ⟶

Where ordinary relays won't do...

...that's where you find CLARE RELAYS



• View of subcarrier frame of Motorola Microwave TV Relay System. Hand lifts cover of one of four Clare Type J Relays used in the push-to-ring circuit of the service channel. Clare relays also provide dependable service in the push-to-talk and the receiver noise squelch circuits. Lower photo shows the Motorola installation near Denver.

MOTOROLA'S Microwave TV Relay System uses 4 Clare Relays per terminal

• High on Lookout Mountain, 3000 feet above the city of Denver, four Clare Type J Relays are in 24-hour service in Motorola's Microwave TV Relay System.

This Motorola Microwave TV Relay System is unique in that a single RF channel is used for a broadcast-quality video signal, a high fidelity audio program channel and a two-way service channel for orders and cuing.

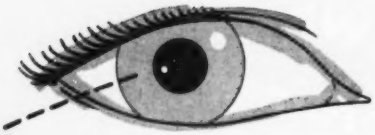
The four Clare relays are mounted under the metallic covers on the subcarrier frame. They were chosen because of the need for maximum reliability of performance and long-life dependability.

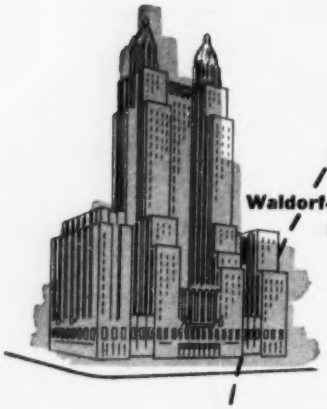
This choice is typical of the confidence placed in Clare relays by engineers in every phase of industry. Clare sales engineers are located in principal cities to consult with you on your specific relay problems. Call the nearest Clare office or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

***FIRST* IN THE INDUSTRIAL FIELD**

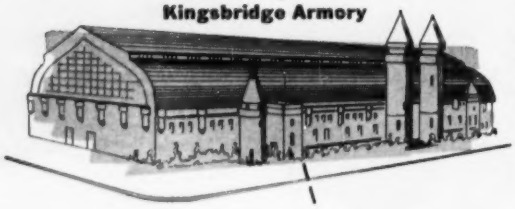
CLARE RELAYS

The eye-opening event of the radio-electronic new year!





Waldorf-Astoria Hotel



Kingsbridge Armory

For the past 12 months the vast, fast-growing radio-electronic industry has been preparing for 4 great days — March 22-25. This is when the IRE National Convention and Radio Engineering Show — the biggest and best ever — will take place in New York City. Be sure to join the other radio-electronic men — nearly 40,000 are expected — who will come, see and appraise the show at which all that is new will be unveiled.

A practical summary of radio-electronic progress will be unfolded at 54 technical sessions during the four-day period. 243 scientific and engineering papers, grouped by related interests, will be presented during these sessions, more than half of which are organized by IRE professional groups. Actually, you will be attending 21 conventions fused into one. New York's finest meeting facilities are provided — the Waldorf-Astoria Hotel plus 3 huge halls in Kingsbridge Armory. Transportation between the two locations is quick, easy — by subway and bus service.

At the show you will find over 600 firms **"spotlighting the new"** in their high-interest product exhibits. These will extend over a mile and a half along avenues appropriately named for radio elements: "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc. These exhibits, an education and revelation in themselves, fill the four-acre space of the great Kingsbridge Armory ... and can be viewed throughout any one or all of the four days.

Admission is by registration only, and serves for the four-day period. For IRE members the cost is only $1.00. For non-members it is a low $3.00, covering sessions and exhibits. Social events have been carefully planned. These are priced separately.

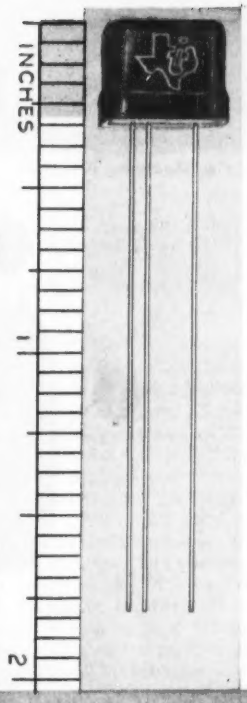
March 22-25, 1954

is the date! New York is the city where the radio-electronic event of the year will take place. Come! See! Enjoy!

THE 1954
IRE NATIONAL CONVENTION
AND
RADIO ENGINEERING SHOW
THE INSTITUTE
OF RADIO ENGINEERS
1 EAST 79th STREET, NEW YORK CITY

For more information circle **35** on inquiry card.

TI transistors will FIT in Your Future!



FORTY PERCENT SIZE REDUCTION has been made in Texas Instruments junction transistor cases. With case length now less than a third of an inch, TI transistors offer you a major opportunity for equipment miniaturization.

This important size reduction was achieved without reducing the quality or changing the construction of the proven TI junction transistor. Transistor fabrication methods, materials, and moisture-proof glass-to-metal hermetic sealing remain the same.

Texas Instruments junction transistors undergo an exhaustive testing procedure to insure their close adherence to published specifications (see distribution curves below). And not only must all transistors pass more than 20 test procedures—in addition to continual visual checks—but also they are aged over 48 *hours* at rated output. They are then completely re-inspected, as a positive operating double-check.

If *you* want transistors combining small size with high quality, they are now in production and available in five types from Texas Instruments Incorporated. Write for bulletins DL-S 310 (junction) and DL-S 312 (point-contact). Custom-built units also are available.

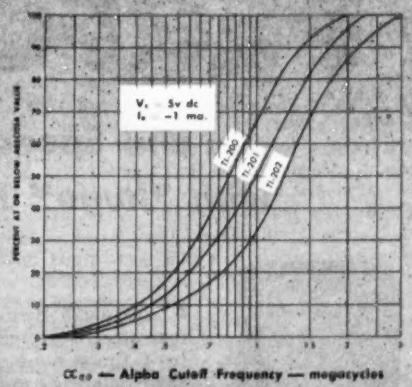
ELECTRICAL DATA:

	n-p-n junction transistors type 200	type 201	type 202	
RATINGS, RECOMMENDED MAXIMUM:				
Collector Voltage	30	30	30	volts
Collector Current	5	5	5	ma.
Collector Dissipation (at 25°C)	50	50	50	mw.
Ambient Temperature	50°C	50°C	50°C	
AVERAGE CHARACTERSTICS (AT 25°C.):				
Collector Voltage	5	5	5	volts
Emitter Current	−1	−1	−1	ma.
Collector Resistance (Minimum)	4	4	4	megohms
Base Resistance	150	170	200	ohms
Emitter Resistance	22	22	35	ohms
Current Amplification Factor* (Minimum)	9	19	49	
Collector Cutoff Current (Maximum)	10	10	10	μa.
Collector Capacitance	15	17	19	$\mu\mu$fd.
Noise Factor** (V_C = 2.5 V., I_C = −.5 ma)	26	23	20	db
Frequency Cutoff** (α_{co})	.90	1.10	1.30	m.c.

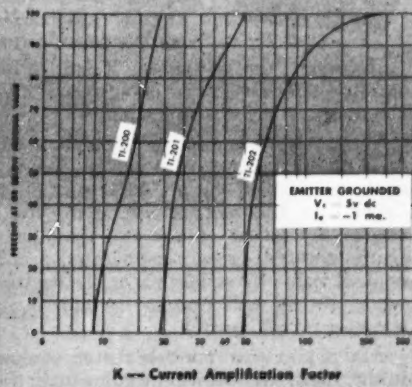
*Emitter Grounded.

**Noise Factor and Frequency Cutoff are average and individual units may vary.

STATISTICAL DISTRIBUTION CURVES
Based on 100 transistors of each type



α_{co} — Alpha Cutoff Frequency — megacycles

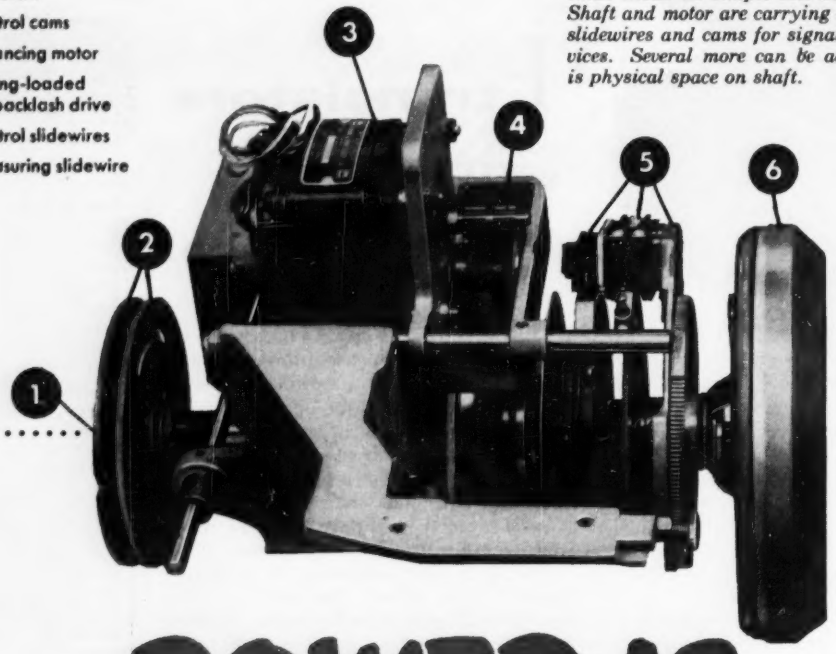


K — Current Amplification Factor

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

For more information circle **36** on inquiry card.

1. Center line of slidewire and shaft
2. Control cams
3. Balancing motor
4. Spring-loaded no-backlash drive
5. Control slidewires
6. Measuring slidewire



This partially dis-assembled view of Speedomax shows its simple line-shaft construction. Shaft and motor are carrying a partial load of slidewires and cams for signal and control devices. Several more can be added; only limit is physical space on shaft.

POWER IS PERFORMANCE

...and Speedomax® Instruments lead with "huge" 12-watt balancing motors!

■ Today's Speedomax instruments provide from 2 to 4 times more power in their balancing motors than do any other available electronic controllers, recorders or indicators.

Because of this power, you'll find the instrument exceptionally fast, agile and dependable, whether the task is routine or unusual.

Do you want to control a process automatically on a time-temperature program—heat, hold and cool at specified rate? We'll put all the extra "gear" on the instrument; give you program control by either of the two standard methods (cam-operated or motor-operated); actuate the control valve by either air or electricity; and the whole set-up will operate as effectively as the simplest on-off control.

And if you want another meter, somewhere else in the plant, to show what's going on in the process, we'll put another slidewire on the instrument's $\frac{3}{8}$" steel shaft, feed it and the remote meter with a "clean" electric supply and give you remote information that you can't tell from the original. *Because of the ample power, you don't lose sensitivity when you load a Speedomax.*

An ample safety factor is as useful in an instrument as in any other industrial equipment. Why not investigate Speedomax for your plant's electronic potentiometers and bridges? You'll find the types described in Catalog ND46(1), and additional information about unusual industrial and scientific uses in Technical Publication ND46. Either or both will be sent on request to our nearest office or to 4955 Stenton Ave., Phila. 44, Pa.

LEEDS NORTHRUP
instruments automatic controls • furnaces

For more information circle **37** on inquiry card.

Editorial Comment

AUTOMATION--

Process Control of Tomorrow

A guest editorial; presented by J. LAWRENCE TECOSKY, *of CDC Control Services, Inc., at the ISA New York Section Winter Conference,* 1953.

CHEMICAL-PROCESS INSTRUMENTATION, or automatic process control, is now well established as a science, and we look to horizons heretofore unimagined.

After observing a modern oil refinery one may feel that we have arrived. Of course, this is only a degree of automation. But this word—newly coined—does imply use of automatic control to a fuller extent. To accentuate this point, consider the following analogy:

The present-day automobile with driver, automatic shift, power steering, directional signals, "Autronic" headlights, etc., is a plant which produces the commodity of transportation. If we can visualize some of the problems encountered in replacing the driver with equipment to close the control loop, we begin to comprehend the meaning of complete automation.

In its broadest aspect, automation in the chemical industry implies that the individual unit processes, and the complex interconnection of these unit processes which represent the production system, are robot supervised. This includes not only steady-state operation, but also shut-downs, start-ups, and interruptions caused by errors of machines or humans; these are normal rather than exceptional. Also implied is feedback intelligence between plant management, the manufacturing process, and the stock pile in order to maintain a desired production rate, fixed or variable, as determined by sales. To carry this even further, economic factors such as labor troubles, technological improvements, power costs, competition, and international affairs, are also important in determining the operation of a plant. Someday these factors may be included in the closed control loop.

Social Problems

This inevitably will change the character of our labor force. The need for unskilled men will decrease sharply. Two basic problems are involved: Will it bring about widespread unemployment? Or will it provide abundance and leisure beyond our hopes? If the latter, are we psychologically equipped to utilize this leisure to advantage? These problems are being considered by economists and social scientists.

Financial Problems

One prime requisite for progress in this field is encouragement from top management, who must consider the control equipment as an integral part of the manufacturing process rather than as a plant appurtanence. This will affect management's over-all plans for expansion, production rates, payroll, efficiencies, and product cost; higher appropriations will be allotted for instrumentation.

Modern chemical construction allows from approximately 5 to 15 percent of the total cost for instrumentation, depending on the industry. In the last ten years there has been a reduction in down time of 6 percent for catalytic cracking units. Approximately half of this gain came from direct use of instruments; the other half resulted from changes in operation and design, many of which were made possible by improvements in automatic control. This proves that a higher percentage of construction and design costs allotted to instrumentation may more than justify the investment.

Technical Problems

Industrial chemistry is growing by leaps and bounds. Studies in chemical kinetics are revealing potential processes in which reactions will take place in fractions of a second. Process specifications may require gas flows at Mach numbers higher than one. Energy releases will be higher than presently known. Temperatures and pressures will be elevated. We can expect nuclear technology to find its way into industrial chemical plants. We shall need new construction materials and better instrumentation. High speed chemical plants will need controllers that operate in fractions of a second; primary instruments, in turn, must be developed to operate at high speeds. Improvements in accuracy and response speed are foreseen in flow, temperature, pressure, level, density, and viscosity measurements.

Basic design of process equipment will be integrated with instrument selection. In a broad sense, the complete plant may be considered a single instrument with the control devices, the distillation towers, the dryers, etc., all being component parts. This integration of design is a real need; too often the instrument engineer is presented with a flow diagram listing process equipment that is impossible to control effectively because of the dynamic factors involved.

Control Engineer

Not only the plant of the future but today's plant has need for a process control engineer. Owing to the broad scope of activity under his direction, he might be called a systems engineer. He is concerned with size of tanks, type of heat exchangers, location of valves, reaction times, efficiencies, yields, and many other problems of the process designer. The design of an instrument installation requires knowledge of processing equipment, plant conditions, operating personnel, and maintenance requirements.

The systems engineer should be capable of applying servomechanism technique for analyzing and synthesizing overall system performance. He must be versed in system dynamics and stability criteria. He should have an appreciation of all design tools, including the analog computer.

Such a systems engineer belongs in the top administration level. However, this type of staff may not be available, or the construction program may not warrant a full-time staff. Previously, instrument manufacturers filled the need to a certain extent; their sales engineers acted as uncompensated consultants.

A more practical approach to the problem is through the services of consulting engineers specializing in that field. Trained staffs capable of performing system design, laboratory development, installation, and start-up supervision are available for specific projects or on a retainer basis. The consultant can work in conjunction with the plant instrumentation force or independently.

The consulting development laboratory also functions as an evaluation service, making independent static and dynamic tests on manufactured instruments. Sometimes a processor desires a construction service to maintain responsibility for his system from the design phase until it is on stream. Some consulting concerns are extending their services into this field.

The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, computing, metering and automatic control—in the form of concise technical descriptions.

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 323

PROCESS CONTROL (and not otherwise classified)

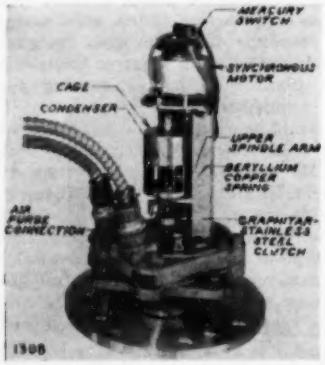
High-impedance Recorder

New recording instrument, especially designed for use with high-impedance d-c. detecting devices, is for installations which require an instrument where source impedance, either fixed or variable, is between 0 and 50,000 ohms. Amplifier of instrument may also be separately used in many a-c. servo applications. Instrument is said to have excellent over-all stray rejection characteristics; and its loading effect on source is negligible. Available with pen speeds of 2, 4½, 12, and 24 seconds. May be used for small current measurement with fixed source impedance, millivoltage measurement with variable source impedance, and high-impedance d.c. bridges. —*Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia* 44, *Pa.*

For more information circle **201** on inquiry card.

Viscosity Transmitter

New "Viscometran" uses same rotating-spindle method as maker's complete "Synchro-Lectric" viscosimeter for continuously measuring viscosity of materials in process, but does not include receiving instrument. It trans-



mits an electric signal to a remote indicator, recorder or controller selected by user. It is mounted on a standard 4-in. pipe flange which may be installed on sample-chamber or directly on processing tank. Pressure limits: 8 mm. vacuum to 100 psig.; any temperature up to 200 F. Two models: "VT-CKQ (variable-capacitance transmitter) available in any range between 0-20 centipoise and 0-50,000 cp.; "VT-PKQ" (variable-resistance transmitter) 0-80 cp. to 0-50,000 cp. —*Brookfield Engineering Labs., Inc.,* 240 *Cushing St., Stoughton, Mass.*

For more information circle **202** on inquiry card.

Electronic Switch and Scanning System

New system for instrument monitoring by electronic scanning cuts cable and installation costs, gives complete information at central panelboard, is self-monitoring, utilizes an electronic switch (non-mechanical in operation). It requires a two-conductor cable connection (or a wireless link) to receiver near control room, rather than multiple-conductor cables and mechanical scanning. On indication panel are rows of labelled miniature lights. Each row is headed by a zone light followed by point lights, each of which can be preset with a different alarm limit. Also on panel are an indicating instrument, point switch, zone switch, lamp test button, reset button, and horn turn-off button. When a limit has been exceeded, a horn sounds and point and zone lights flash on. Operator turns off horn, and turns zone and point switches to indicated zone and point. Instrument then indicates value of measured condition at alarming sensing element. During this point reading, or during any logging of all points, scanning and alarm indication continues uninterrupted. Equipment is self-monitoring, both alarm and instrument indicating failure of any circuit element. Developed primarily for temperature monitoring, system can also be used for monitoring flow-rate level, pressure, viscosity, pH, etc., also for fire protection, multiplexing, and telemetering.—*The Kybernetes Corp.,* 1108 *Raymond Blvd., Newark* 5, *N. J.*

For more information circle **203** on inquiry card.

Electricity Self-teaching Kit and Manual

New "Beginner's Experimental Kit in Electricity," said to be "entirely different in concept from any other instruction equipment in this field presently available," is designed so that a student can teach himself the principles of d.c. and a.c. by constructing and operating all of the more than 190 assemblies described in the accompanying 240-page manual. —*Universal Scientific Co., Inc.,* 1102 *Shelby St., Vincennes, Ind.*

For more information circle **204** on inquiry card.

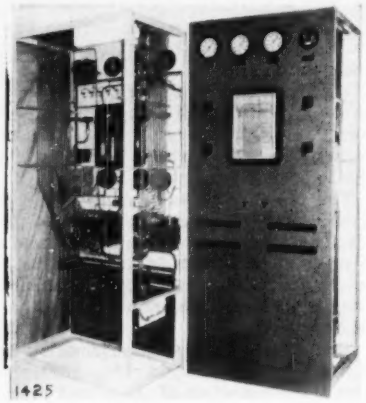
Remote Controller

New "Model PV5010 Remote Controller for Grove Regulator" permits positioning of Grove regulator electrically from remote station; produces 10 ft.-lbs. available torque at regulator pickup; provides for position indication at operator's station.—*Avionic Products Engineering Corp., Route No.* 46, *Dover, N. J.*

For more information circle **205** on inquiry card.

Automatic-control Cubicles

New automatic control cubicles for power, process and chemical industries include relay control centers, drum controllers, sequence timing

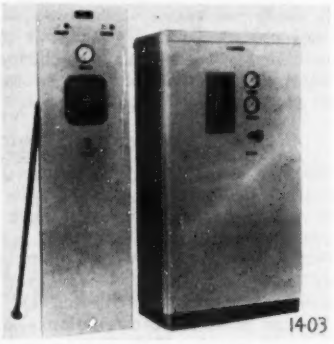


units, indicating and recording instruments. All pneumatic tubing is brought to bulkhead fittings and all wiring to easily-accessible terminal blocks. Tubing and wiring are installed to permit ease in tracing circuits and making connections.—*Lake Erie Electric Mfg. Co., Inc.,* 2052 *W. 22nd St., Erie, Penna.*

For more information circle **206** on inquiry card.

Chlorinator

New "Figure 1052 Ratachlor" is a line of high-capacity chlorinators said to offer "unique features of simplicity, wide operating range, and



dependability for municipal and industrial chlorination." Units handle up to 6000 ppd with either manual or automatic proportioning; are designed about an all-vacuum solution feed system. A direct-reading flow meter enables operator to spot any change in chlorine flow rate when there is an adjustment in chlorine rate valve.—*Fischer & Porter Co., Hatboro, Penna.*

For more information circle **207** on inquiry card.

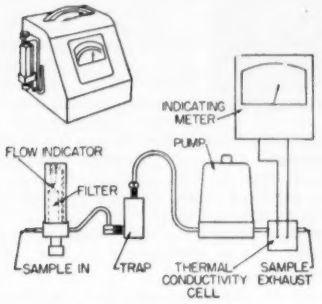
Heat Extractor

New "Model TX-50" package type heat extractor employs evaporative cooling principle, will supply cooling water as low as 86 F. at 75 F. wet-bulb condition. Capacities from 36,000 to 465,000 Btu/hr. with entering water at 90 F. to 160 F. Cooling-water flow-rate from 20 to 150 gpm. Among features: full automatic temperature control; equipment to heat circulated water to control point on cold start-up; safety controls; motor starters and switches. Unit is completely assembled, wired, and piped, for ease of field installation.—*Mayer Refrigerating Engineers, Inc., Lincoln Park, N. J.*

For more information circle **208** on inquiry card.

CO_2 Analyzer

New portable apparatus draws continuous flue gas sample from small boilers and heaters; yields CO_2 reading within 20 seconds. Readings change

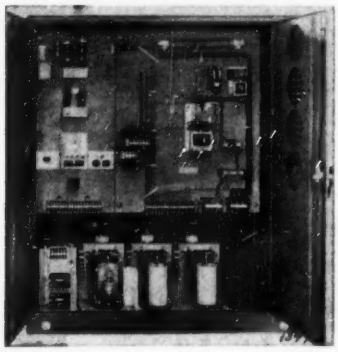


5 seconds after a change has occurred in gas. Instrument has 0-20 percent range, accuracy 0.25 percent.—*Thermco Laboratories, Michigan City, Ind.*

For more information circle **209** on inquiry card.

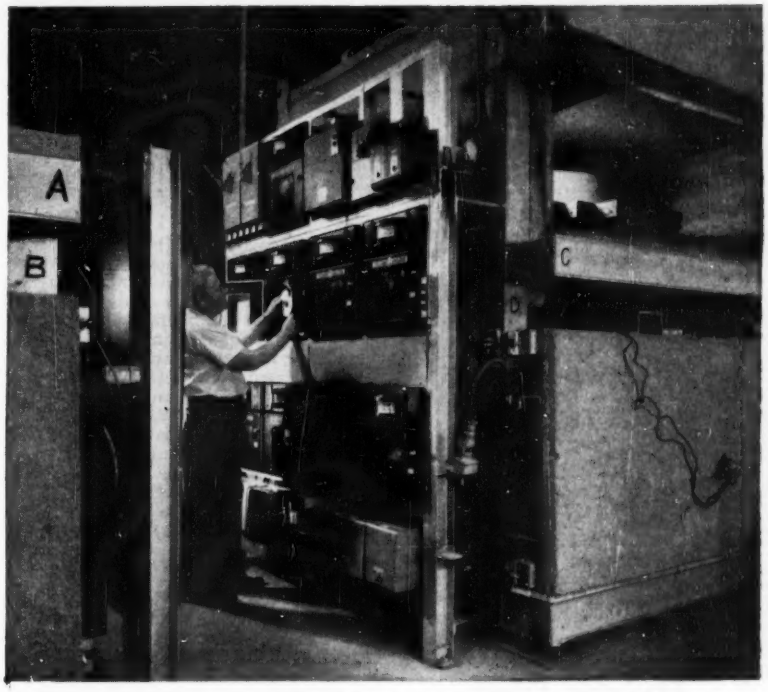
Mercury-rectifier Drive for Adjustable-speed Service

New "Xatron V*S Drive" utilizes new "Xatron" single-anode mercury-pool rectifier tube to supply controlled d-c. variable voltage; comprises (1) operator's control station, (2) adjustable-speed drive motor, and (3) control unit. New control unit is lighter (and for 40- and 50-hp. drives smaller) than control units including rotation conversion equipment. Because of inherent regulation at all speeds, new drive provides wide speed ranges (example 105-1700 rpm). Other performance features are said to be:



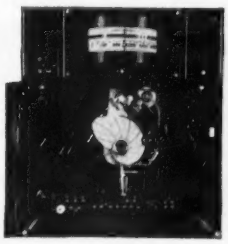
BARBER COLMAN

Wheelco Chronotrols



...control critical annealing cycles at HAYWARD SCIENTIFIC GLASS CORP.

• For a low-cost control system that's tops in performance, Hayward Scientific Glass Corp., Whittier, California, specifies Wheelco Chronotrols. They provide completely automatic, precise control of critical annealing cycles in the manufacture of high-quality optical glass. Chronotrols can give you this same low-cost control in a wide selection of heating and cooling programs for ceramic and glass processing jobs. Write for Bulletin CH-2.



Automatic control . . . wide program range!

Improve product uniformity . . . save time and manpower by controlling time-temperature heating cycles automatically. Give exact heating and cooling temperature . . . desired process time.

BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Small Motors
OVERdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

For more information circle **38** on inquiry card.

smooth and powerful starting, stepless acceleration, close speed regulation, fast response, high overload capacity, conveniently centralized control, power applied directly, quiet operation, savings in floor space, installation economy, and minimum maintenance.—*Reliance Electric & Engineering Co.*, 1088 *Ivanhoe Road, Cleveland* 10, *Ohio.*

For more information circle **210** on inquiry card.

Proximity Relay

New "Silent Sentry" can be used to start and stop electrically-driven devices and machines, sound alarms, etc.; is operated by a person coming

close to but not touching it. Sensitivity can be adjusted. Installation can be made by untrained personnel.—*R. G. Genzlinger, Inc., Neshaminy, Penna.*

For more information circle **211** on inquiry card.

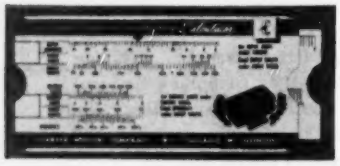
Flushable Filters

New "Model H" (1-in. pipe connection) and "Model K" (2-in.) for industrial applications are added to maker's line of all-bronze "Por-O-Met" reverse flushing filters; are guaranteed by maker to remove all suspended foreign matter and deliver clean, clear liquids. "Lifetime" elements, made of sintered bronze, micro-porous porcelain (ceramic) or porous alunlum, are available in grade sizes for removing foreign matter from passing sizes of 100 microns down to 0.5 micron. Flow rate is in proportion to pipe carrying capacity "with negligible pressure drop." No replacement of filter elements is required.—*Homefiltr Co., North Brookfield, Mass.*

For more information circle **212** on inquiry card.

Dynamotor Calculator

New "Dynamotor Performance Calculator," of slide-chart form, helps to quickly compute efficiency and regula-

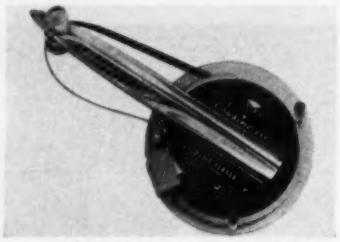


tion of dynamotor Power Supplies of various types and makes under actual operating conditions.—*Dep't* 22, *Carter Motor Co.*, 2644 *N. Maplewood Ave., Chicago* 47, *Ill.*

For more information circle **213** on inquiry card.

Tape-record Repeater

New "Audio-Vendor" is an automatic audio message-repeating device embodying a magazine of magnetic tape. When actuated by remote con-



trol, it continuously repeats messages (from 15 sec. to 15 min. long). Magazine fits any standard tape recorder. Tape is pulled from center of a reel and automatically rewound on outside. Prime industrial application is safety promotion; another is use of audio frequency notes, recorded on tape, to trip relays and command controls in proper sequence for operating automatic machinery, with tapes filed for future use saving much time in all future setups.—*Cousino, Inc.*, 2488 *Madison Ave., Toledo* 2, *Ohio.*

For more information circle **214** on inquiry card.

Tape-record Repeater

New "Message Repeater," announced as "The Machine That Talks at the Sight of a Human Being," differs from average tape recorder in that it repeats the same message without rewinding. It has built-in speaker, but outdoor loudspeakers can be plugged into it. Old messages are changed by flicking a switch and talking new message into machine: new message erases old one. Cycle may be set for any period up to 2 min. Maker can supply microphone, foot-mat actuator, photoelectric relay, etc.—*Michigan Electronics, Inc.*, 854 *N. Rockwell St., Chicago* 14, *Ill.*

For more information circle **215** on inquiry card.

TIME AND COUNT

Low-cost Time Switch

New "Type B," said to be "a quality time switch for the low price field," is a NEMA Standard 30-amp. s-p. s-t. switch employing slow-speed hysteresis motor and synchronous timing mechanism used in maker's

heavy-duty time switches; heavy silver contacts; insulating safety shield; four levers for two ON and two OFF operations, and easily-manipulated trippers.—*Sangamo Electric Company, Springfield, Illinois.*

For more information circle **216** on inquiry card.

Master Clock

New radio-supervised master clock, designed to provide time control coordinated with National Bureau of

Standards' broadcast time, can keep all clocks, time equipment and signaling devices in maker's electronic or electric self-regulating time systems on time. It contains a short-wave radio receiver which is tuned to NBS signals. Once each hour, it compares its accuracy with NBS and, if incorrect, resets itself. A radio speaker can be switched on to permit visual checking of master's time to periodic voice time announcements broadcast on same frequencies as signals. If, because of poor reception, master does not receive broadcast time tone, it will attempt to pick up succeeding tones, which are broadcast every ten minutes, until a check is made.—*International Business Machines Corp.*, 590 *Madison Ave., New York* 22, *N. Y.*

For more information circle **217** on inquiry card.

Running-time Recorder

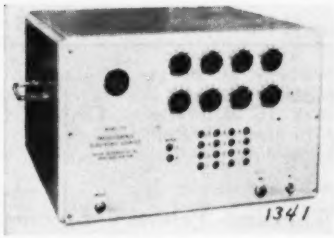
New "Model M Servis Recorder" provides an immediately-visible record of busy and idle time of plant ma-

chinery; utilizes a sapphire stylus on a 6-in. 24-hr. wax-covered chart which rotates 3 times (3 days and nights on single chart). 12-hr. and 8-hr. charts also available. To prevent unauthorized opening of recorder, chart shows whenever case was locked or unlocked. If desired, an elapsed-time counter is included.—*The Service Recorder Co.*, 1375 *Euclid Ave., Cleveland* 15, *Ohio.*

For more information circle **218** on inquiry card.

Predetermined Counters

New "200 Series" predetermined electronic counters includes twelve models to meet nearly every control application, plus a variety of photoelectric, magnetic, impact, and stylus pickups. Typical "Model 244" shown is dual-sequence counter, provides count ranges from 1 to 10,000 and count-



ing rates to 60,000 per minute in each of two channels (independent settings). At end of each predetermined channel count, either a relay contact closure or a voltage pulse is provided. Switching between channels and reset of channels is automatic and instantaneous.—*Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.*

For more information circle **219** on inquiry card.

TEMPERATURE

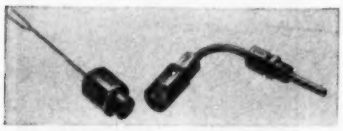
Automatic Control Systems for Furnaces and Ovens

New "Bristol-Beck Control Packages," individually designed for specific furnace, oven, kiln or dryer applications, are designed to operate on-off or proportional fuel valves or electric contacts, in a variety of control actions including proportional, proportional-input, on-off, or time-program; automatic reset is also available. Each package consists of all components necessary for a complete installation, including a Bristol "Dynamaster Pyrometer," a Beck relay or Putmo controller, and a Beck motor operator. In addition, all necessary primary measuring elements, electric and air-operated control valves, combustion safeguards, panels and accessories are available in each single-package installation. Ten different basic packaged systems are offered, each with numerous variants, enabling a designer to select a complete control system engineered to satisfy his particular requirements.—*The Bristol Co., Waterbury 20, Conn.*

For more information circle **220** on inquiry card.

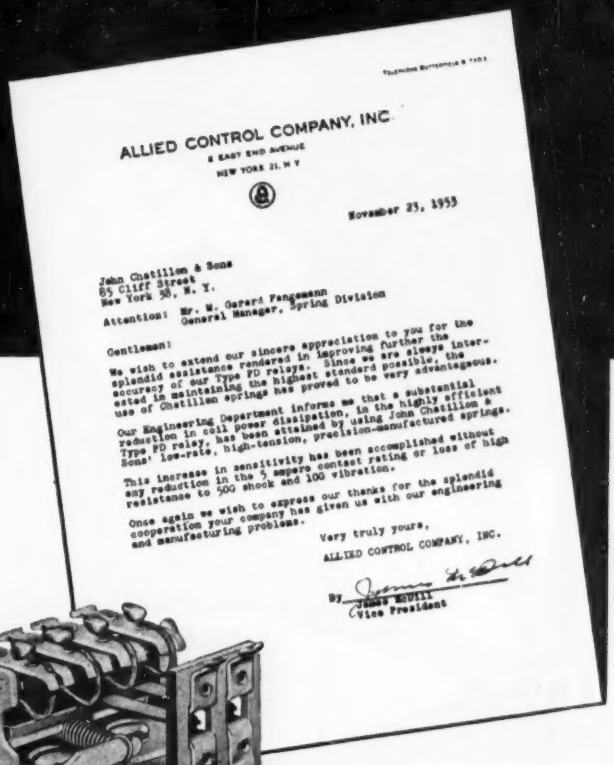
Quick-disconnect TCs

New "Quick-Disconnect Thermocouples" are water-tight and vapor-proof; facilitate assembly and disassembly by plugging polarized jacks



together and turning nut finger-tight; are available as complete thermocouple assemblies or as component parts; permit equipment manufacturers to ship reactors, furnaces, etc., with TCs installed, without exposing lead wires: connections can be plugged to instruments afterwards. Fast response is obtained by using a small-diameter stainless-steel protection tube. Iron-Constantan, copper-Constantan and Chromel-Alumel

HOW CHATILLON CUSTOM SPRING DESIGN IMPROVED THE SENSITIVITY OF ALLIED CONTROL RELAYS



ALLIED CONTROL COMPANY, INC.
2 EAST END AVENUE
NEW YORK 21, N. Y.

November 23, 1953

John Chatillon & Sons
85 Cliff Street
New York 38, N. Y.

Attention: Mr. W. Gerard Fangemann
General Manager, Spring Division

Gentlemen:

We wish to extend our sincere appreciation to you for the splendid assistance rendered in improving further the accuracy of our Type PD relays. Since we are always interested in maintaining the highest standard possible, the use of Chatillon springs has proved to be very advantageous.

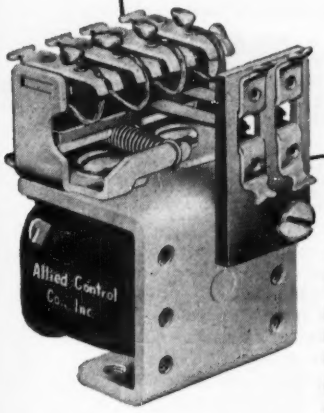
Our Engineering Department informs me that a substantial reduction in coil power dissipation, in the highly efficient Type PD relay, has been attained by using John Chatillon & Sons' low-rate, high-tension, precision-manufactured springs.

This increase in sensitivity has been accomplished without any reduction in the 5 ampere contact rating or loss of high resistance to 500 shock and 100 vibration.

Once again we wish to express our thanks for the splendid cooperation your company has given us with our engineering and manufacturing problems.

Very truly yours,
ALLIED CONTROL COMPANY, INC.

By James Scull
Vice President



John Chatillon & Sons has at your service one of the world's outstanding spring design and research departments. We have designed and manufactured all springs used in famous "Chatillon Scales" as well as in practically every important force measuring device.

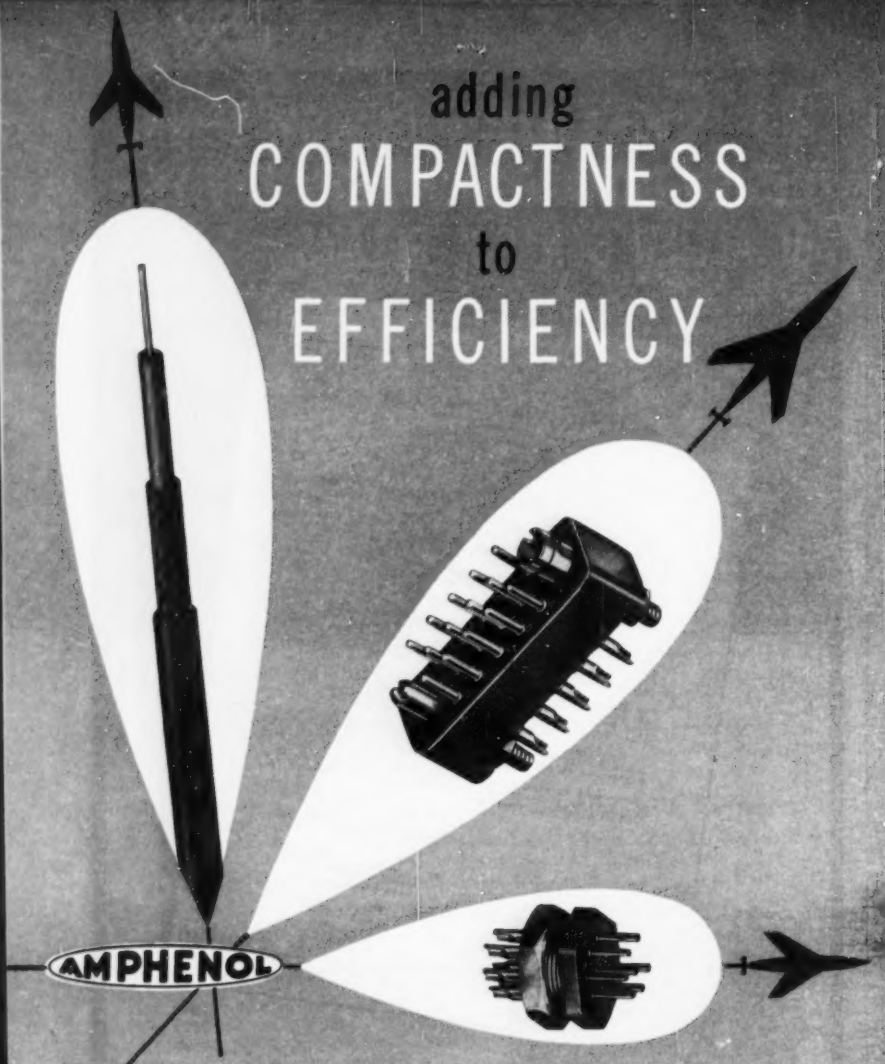
In keeping with a tradition of continuous research for over 118 years, Chatillon developed an exclusive spring alloy with the assistance of Professors A. V. DeForest of M.I.T. and F. Sayre of Union College. This alloy called "Iso-Elastic" is the ultimate in spring materials—a temperature-compensated material having extremely low hysteresis and draft characteristics.

If you have any spring problem, using any material from music wire to the specialized nickel alloys, contact the Chatillon Spring Division for assistance in redesigning your present springs. Engineering bulletins on Iso-Elastic Alloy and Springs are available upon request.

JOHN CHATILLON & SONS
85 CLIFF STREET, NEW YORK, N. Y.
Manufacturers of Precision Springs and Measuring Apparatus Since 1835

For more information circle **39** on inquiry card.

adding
COMPACTNESS
to
EFFICIENCY



American aircraft manufacturers today build planes that have capabilities thought impossible just a few years ago. A large part of their success has been due to the inclusion of more and better electronic equipment in each new model. But, the use of this additional equipment has created new problems for aircraft designers, particularly those of space and weight.

One answer to these difficulties is the miniaturization of electronic equipment, and working on the components for this have been the engineers of AMPHENOL. From their engineering skill have evolved many of the new components needed to add *compactness* to *efficiency*—AMPHENOL miniature connectors and cables included in new compact electronic assemblies have helped solve many of the problems created by the trend toward miniaturization.

AMPHENOL is the world's largest *single source* manufacturer of approved AN connectors, RF connectors and coaxial cable. At your service to assist you with applications of these components is the AMPHENOL Engineering Counseling Service, who will also work with you in the modification of AMPHENOL components or the design of totally new units to your specifications.

AMPHENOL

AMERICAN PHENOLIC CORPORATION, *chicago* 50, *illinois*

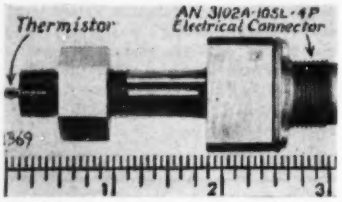
NEW INSTRUMENTS

available in 20 gage; materials of contact pins and sockets correspond with TC calibrations.—*Conax Corp.*, 4515 *Main St.*, *Buffalo* 21, *N. Y.*

For more information circle **221** on inquiry card.

Thermal Primary Elements

New "Types T1 and T2, Model Z-5008-1" pressure-tight corrosion-resistant temperature-responsive pri-



mary-element assemblies utilize fast-response thermistors whose resistances change by 725 percent and 1003 percent respectively for temperature changes from 0 C to 50 C. Range extremes are –60 C and 300 C.—*Avionic Products Engineering Corp., Route No. 46, Dover, N. J.*

For more information circle **222** on inquiry card.

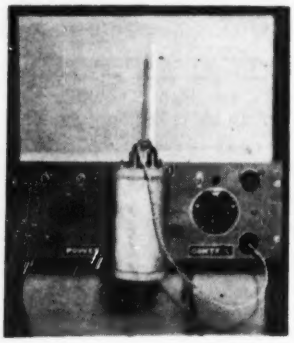
Thermistor Kit

New inexpensive "Model 168 Experimental Thermistor-Varistor Package" contains two plain thermistor washers, two thermistor disks, two thermistor beads, and one varistor washer, plus a technical information sheet of simple circuitry and electrical characteristics of these units. Price of kit is said to be one-third of total of component prices.—*Victory Engineering Corp., Springfield Rd., Union, N. J.*

For more information circle **223** on inquiry card.

Standardizing Equipment for Thermometers and TCs

New "Model Hg-1" of maker's "Calibreg" for calibrating thermocouples and thermometers is avail-

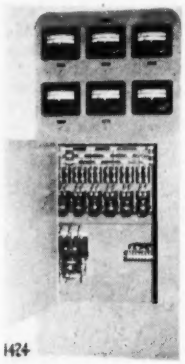


able in 20-C. ranges up to 430-450 C.; maintains desired temperature within 0.01 C. Oven is 7 in. high, has five 0.32-in. diam. cavities 5 in. deep. Special models are also available for temperatures up to 1500 C.—*Weiller Instruments Corp., 95 Broad St., New York 4, N. Y.*

For more information circle **224** on inquiry card.

←Circle **40** on inquiry card.

Pyrometer Control Panels



New pyrometer control panels for use in process, chemical, plastic, and cracking plants, are each designed to meet individual requirements; feature accessible terminal connection, relays and components for ease in testing and installation. Also available with indicating and recording instruments.—*Lake Erie Electric Mfg. Co., Inc., 2952 W. 22nd St., Erie, Penna.*

For more information circle **225** on inquiry card.

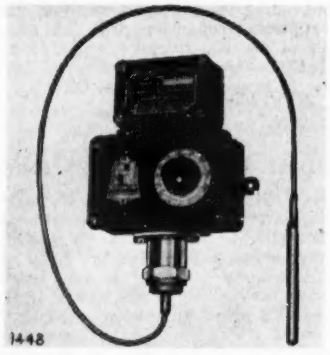
Appliance Thermostat

New "Tri-Snap" low-cost thermostat has quick-make and quick-break at minimum differential between "on" and "off," making it useful in appliances where a slow-acting thermostat might cause radio interference. Adjusting screw is easily designed in varying lengths and contours to meet special location and knob or dial attachment requirements. "Tri-Snap" is available with adjustable or non-adjustable temperature range; standard range –80 F. to 300 F.—*Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.*

For more information circle **226** on inquiry card.

Explosion-proof Temperature Controller

New "Model VS" non-indicating explosion-proof mercury-actuated temperature controller has been approved by Underwriters' Laboratories, Inc. for use in five specified atmospheres. It can be supplied with a calibrated



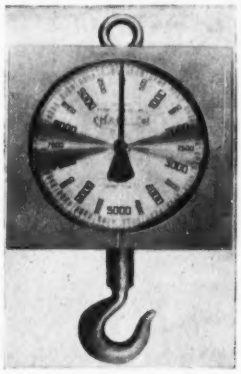
temperature setting scale; uncalibrated model ("0"-"50" dial) is for applications where close control is desired without disclosing temperature of process. Switch is rated 4 amps. at 125 volts, 2 amps. at 250 volts, non-inductive a.c.; for pilot duty 50 va. inductive load. Controller is designed for use with either two- or three-wire control circuits. Temperature-range extremes are —30 F. and 1200 F.—*The Partlow Corp., New Hartford, N. Y.*

For more information circle **227** on inquiry card.

SCALES, etc.

Heavy-duty Crane Scale

New "Model No. 16-10000DH" heavy-duty dynamometer crane scale will withstand rough service which

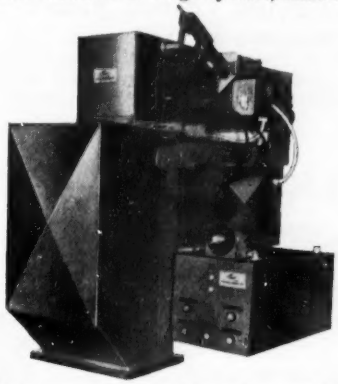


would ruin other types of weighing apparatus. Capacity 10,000 lbs. calibrated in increments of 25 lbs.; 15-in. diam. Aluminum dial is recessed and covered with plexiglass. Each unit has four special-alloy steel springs, precision-calibrated and designed with a large factor of safety, which measure force and also serve to absorb shock.—*John Chatillon & Sons, 85 Cliff St., New York 38, N. Y.*

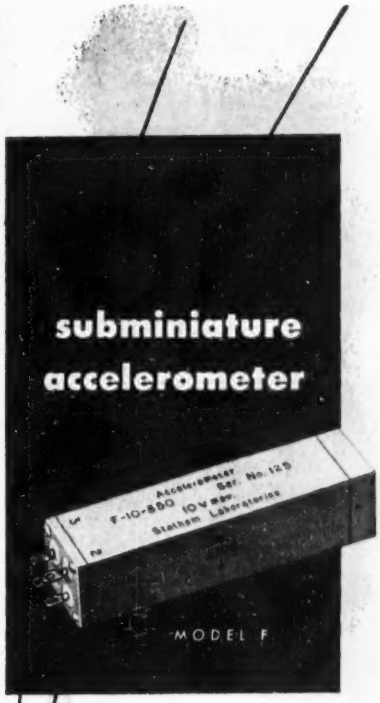
For more information circle **228** on inquiry card.

Filling Scales

New "Models 1000G and 1000N Filling Scales" utilize a feeding mechanism of unique design which, coupled with maker's leverage system, enables



high tonnage handling of materials weighing from 10 to 160 lbs. per cu. ft. Any material that does not flood can be handled. "Model 1000G" is a gross weighing scale used in direct filling of open-mouth bags, drums or cartons; may be furnished with a wide choice of bagholders; also casters and locking screws for moving from one filling station to another. ★ "Model 1000N" (illustrated) is a net-weighing scale for automatically pre-weighing loads to be discharged into an open-mouth bag, drum or carton, valve bag packing machine, or to a blender or conveyor for batching purposes. It handles up to 12 bags per minute of any desired weight from 25 to 200 lbs. within weight tolerances of one or two ounces. Automatic elec-



To detect and measure static or dynamic acceleration in ranges from ±2 g to ±100 g, the Model F accelerometer is available for applications requiring miniature components.

Weighing less than one ounce, this accelerometer can be attached to light machine parts without altering their dynamic performance, or it may be inserted into small spaces previously inaccessible for vibration measurements. At no sacrifice in performance, extremely small size and weight are emphasized in the Model F accelerometer.

Please request Bulletin No. 4.0.

Statham LABORATORIES
• Los Angeles 64, Calif.

For more information circle **41** on inquiry card.

tric or mechanical controls available for varying loads, frequency of dumps and number of dumps per cycle.—*Thayer Scale and Engineering Corp.*, 492 *E. Water St., Rockland, Mass.*

For more information circle **229** on inquiry card.

Filling-machine Control

New computer equipment, for use with maker's "Selectrol" (which automatically checkweighs each package or production unit on conveyor line), provides automatic statistical quality-control; comprises "Average and Range Computer and Control Indicator," and "Average and Control Chart Plotter." Average Computer calculates average weight of groups, compares to preset limits, actuates Control Indicator, and feeds calculated average to Average Control Chart Plotter. Range Computer calculates difference between maximum and minimum weight units in each group and indicates when spread is larger than normal. Plotter records average (X) and range (R) for weights of every ten consecutive packages or units as they are checkweighed. Averages and ranges are recorded while chart is intermittently driven, so that record is presented as so many averages and ranges per unit of chart length. Warning lights for control limits on averages and ranges may be adjusted to operate at any value.—*The Exact Weight Scale Co.*, 944 *W. 5th Ave., Columbus* 8, *Ohio.*

For more information circle **230** on inquiry card.

PRESSURE, VACUUM, etc.

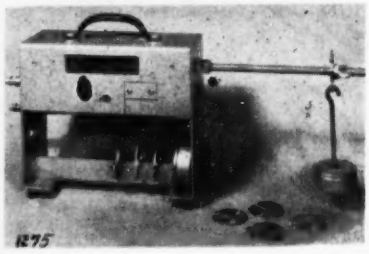
Wide-range Liquid-column Pressure Gage

New "I-V Gage," for plus, minus and differential readings, has plunger-type oil-level adjuster; will serve as air filter gage, static pressure indicator, draft gage, air velocity meter, etc. Ranges: 0-3-in. and 0-7-in. water; low-range accuracy: 0.01 in. water. Also available in a direct-reading air-velocity model for use with a Pitot tube, ranges 0-7000 and 0-10,500 fpm.—*F. W. Dwyer Mfg. Co.*, 317 *S. Western Avenue, Chicago* 12, *Ill.*

For more information circle **231** on inquiry card.

Medium-pressure Calibrator

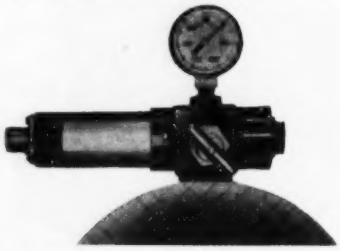
New pneumatic calibrator for testing and calibrating pressure instruments which operate between 20 in. water and 25 psi. produces any predetermined pressure by adding or removing calibrated weights from a weightbeam; is fully portable, permitting use in field as well as in shop. It can be used, in many cases, to check instruments without removing them from their mounting; also for checking instruments on a production basis. It operates from a 35-psi. air source.—*Republic Flow Meters Co.*, 2242 *Diversey Parkway, Chicago* 47, *Ill.*



For more information circle **232** on inquiry card.

Airborne Gas Pressure Bottle Control Valve

New "MV 57" light-weight valve for complete control of gas pressure bottles is an internally-piloted high-capacity 5-in-1 control valve featuring on-off pressure relief, drain, gage and check operations, providing instant action at working pressures to 3500 psi. It is said to be a vital contribution towards fast trouble-free starts for jet engines.—*Marotta Valve Corp., Boonton, N. J.*



For more information circle **233** on inquiry card.

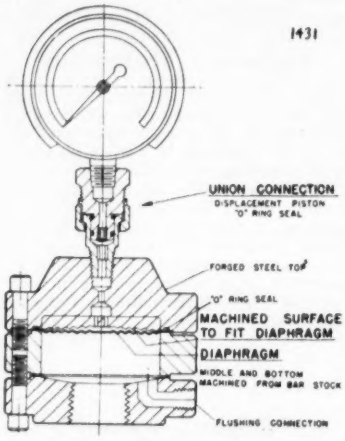
Overpressure Safeguard

New "Gauge Guard" protects against overranging of pressure gages or loss of fluid from manometers by positively shutting off line pressure at whatever pressure is set with the adjustment knob. It reopens as soon as pressure falls approx. 0.25 psi. below closure point. A lock wire feature is included to seal closure-point adjustment if desired. Models are available for pressures from 2 in. water column to 5,000 psig., in either aluminum body with brass trim or all Type 316 stainless steel (other materials on special order). Two major applications: (1) to protect gages from excessive line pressure that may occur during emergency conditions; (2) for wide-range pressure measurement to automatically protect low-range gages when high pressures are applied to a common manifold.—*Industrial Engineering Corp.*, 2720 *Vine St., Cincinnati* 19, *Ohio.*

For more information circle **234** on inquiry card.

Pressure-instrument Seals

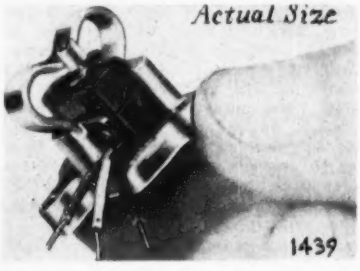
New "Continuous Duty Diaphragm Seals" prevent corrosion or clogging of pressure instruments and protect against over-range; are available in ten models and three forms. Illustrated is "Removable Instrument" type. When instrument is mounted, union connection displaces a given volume of filling liquid and moves diaphragm away from machined-shape top to optimal operating position, so that (1) instrument can be removed and replaced without interrupting production and (2) accuracy of highest-precision gages is unaffected.—*Mansfield & Green*, 1051 *Power Ave., Cleveland* 14, *Ohio.*

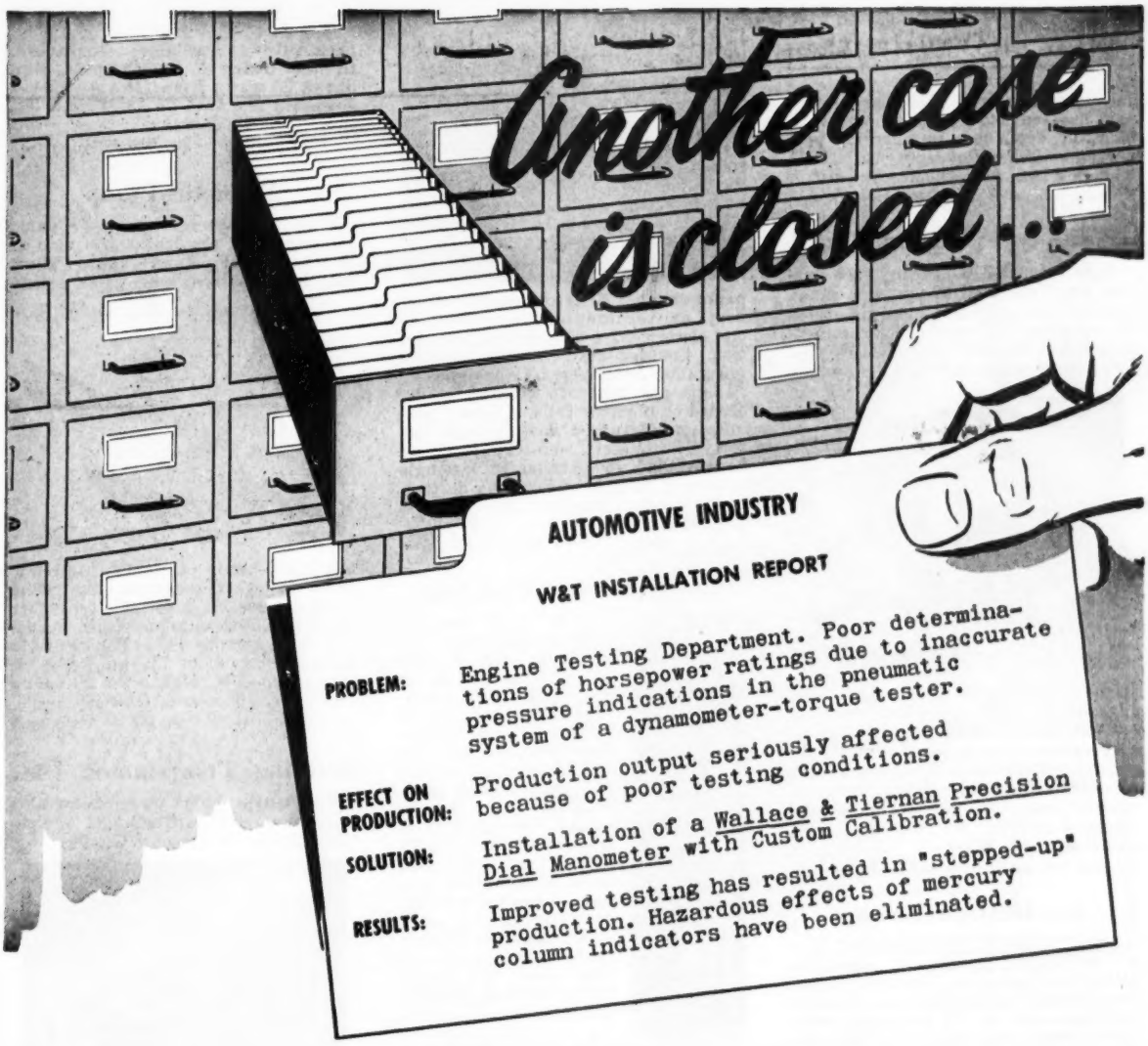


For more information circle **235** on inquiry card.

Miniature Pressure Switches

New "BM Series" pressure switches, suitable for all airborne pressure control applications, are available in any pressure range from 100 to 10,000 psi. Unit weighs approx. ¾ oz., is designed around maker's newly developed "B-tube" pressure measuring element which is vibration-resistant, inherently straight-line in operation,




another case is closed...
AUTOMOTIVE INDUSTRY
W&T INSTALLATION REPORT
PROBLEM: Engine Testing Department. Poor determinations of horsepower ratings due to inaccurate pressure indications in the pneumatic system of a dynamometer-torque tester.
EFFECT ON PRODUCTION: Production output seriously affected because of poor testing conditions.
SOLUTION: Installation of a Wallace & Tiernan Precision Dial Manometer with Custom Calibration.
RESULTS: Improved testing has resulted in "stepped-up" production. Hazardous effects of mercury column indicators have been eliminated.

...Thanks to a W&T Precision Instrument

W&T Precision Dial Manometer

FEATURES:

Full protection against overpressure

Custom calibrated scales in units of force or torque

Two revolution indicator provides scale 45 in. long with only an 8½ in. diameter dial.

Sensitivity one part in 10,000; accuracy one part in 1000.

If you have a problem in the measurement or control of pressure, write today for additional information.

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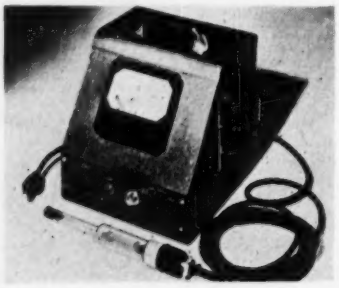
A-93

and low-hysteresis. Units are available in a variety of mountings, with manifold type base in quantity production.—*Miller-Robinson Co.*, 7007 *Avalon Blvd., Los Angeles* 3, *Calif.*

For more information circle **236** on inquiry card.

Pirani-type Vacuum Gage

New "Model 516" Pirani type vacuum gage operates in pressure range between 1.0 and 0.001 mm. Hg (1000 to 1 microns). Features: low-impedance power rectifier that obviates need for voltage adjustments during oper-



ation, one indicator for both voltage adjustment and pressure reading, built-in compensating element, and incorporation of outgassing circuitry on pressure-range-selector switch, which permits outgassing at any pressure without danger to filament.—*National Research Corp.*, 70 *Memorial Dr., Cambridge* 42, *Mass.*

For more information circle **237** on inquiry card.

Acceleration Pickup

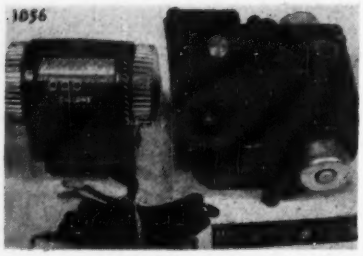
New "Model A Accelerometer" is a self-generating piezoelectric vibration pickup delivering an electrical signal proportional to acceleration. Made of stainless steel, it will fit into a ¾-in. cube; weighs less than 1.5 oz. Electrical connection is by subminiature coaxial connector and cable designed especially for high-impedance circuits; cable is designed to minimize spurious signals developed in ordinary cables by cable vibration or shock. Sensitivity of unit is better than 15 mv./*G* when used with maker's "Matching Amplifiers." Natural frequency of unit is above 9,000 cps.; its frequency response is flat within 5 percent from 5 to 2,000 cps. —*VibraShock Corp.*, 6114 *River Rd., Washington* 16, *D. C.*

For more information circle **238** on inquiry card.

FLOW-RATE, VOLUME, etc.

Vehicle Fuel Meter

New "McCullough Fuel Flow Meter" registers volume, up to 999.99 gallons, of fuel used during any time interval (or while vehicle is covering any distance). It is said to "duplicate or exceed the accuracy of most laboratory equipment." It operates on 6-volt supply; weighs 2 lbs.; comprises (1) diaphragm-type positive metering device which mounts between fuel pump and carburetor; and (2) counter which mounts on instrument



panel or other desired location. Meter body and counter are connected by one electric wire plus ground connection. Counter receives 800 impulses per gallon from meter. Capacity is 15 gallons per hour; if capacity is exceeded or if meter fails, a bypass permits uninterrupted flow through meter. Two meters and counters can be installed in parallel in a single system if 30-gph. capacity is desired. —*Tracktest Equipment Co., Box* 499, *Franklin, Mich.*

For more information circle **239** on inquiry card.

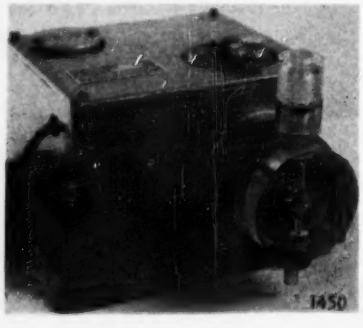
Remote-reading Tank Gage

New "Keco" remote-reading tank gage, for use with vented fuel oil, gasoline and diesel oil tanks to 9-ft. depth, shows depth of fuel in inches; can be located near furnace, etc., at any desired elevation. Etched-aluminum scale plate has four different scales, for fuels of a wide range of API gravities. Only one scale is visible at any time. Gage utilizes hydrostatic balance principle; has no moving mechanical parts except small air pump built into case. Installation consists in mounting a ½-in. pipe in tank and connecting a ¼-in. copper tube from tank to gage. —*King Engineering Corp., Box* 310, *Ann Arbor, Michigan.*

For more information circle **240** on inquiry card.

Solution Feed Pump

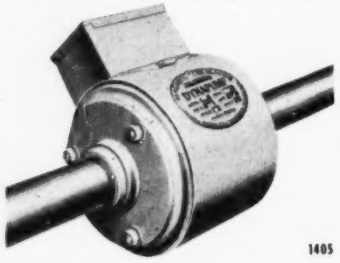
New "Model S Chemical Solution Feed Pump" is of positive-displacement and reciprocating-diaphragm type with transparent plastic pumping chamber, for feeding small volumes (adjustable up to 60 gal. per day) of chlorinating or other solutions against pressures up to 150 psi. (for negative pressures an anti-syphon valve is available). Guaranteed to meet Board of Health specs. Unit draws 90 watts from 115-v.ac. line.—*Precision Machine Co.*, 8 *Walnut St., Somerville* 43, *Mass.*



For more information circle **241** on inquiry card.

Magnetic Pump

New "Dynapump" magnetic pump for circulator applications is said to be exceptionally quiet; has no shaft seal or motor bearings; gives unusu-

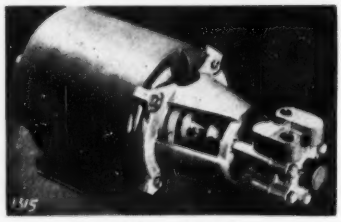


ally high heads of 24 ft. All pump parts being of corrosion-eliminating stainless steel, it is suitable for either fresh or closed water systems. Standard unit accepts interchangeable flanges from ¾ to 1½ in. Two-year warranty.—*The Fostoria Pressed Steel Corp., Fostoria, Ohio*

For more information circle **242** on inquiry card.

Metering Pump-motor Unit

New close-coupled pump-motor unit requires no outboard support or special alignment; fits new GE frac.-hp.



motors and bolts directly to motor housing. Pump is standard type with two opposed axially-oscillating impellers equivalent to duplex piston action, providing continuous non-surge flow. Pressures to 150 psi.; capacities to 10 gpm.; non-foaming.—*Eco Engineering Co.*, 12 *New York Ave., Newark, N. J.*

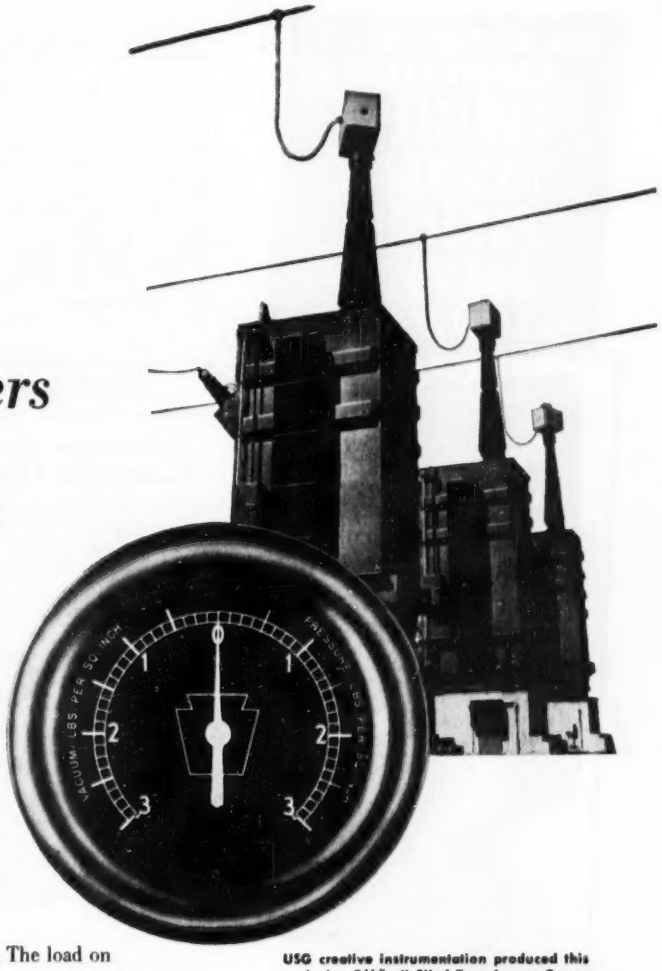
For more information circle **243** on inquiry card.

Flow-rate Controller

New self-operated Flow Regulator can be screwed directly into a pipeline; maintains pre-set flow-rate despite changes in upstream or down-

stream pressure; offers flow control for applications which do not justify pneumatic or electric control equipment but cannot be trusted to manual

How to tell when transformers suffer from high or low blood pressure



Transformers are sensitive to temperature changes. The load on transformers of the inert-air or gas filled types increases or decreases with the ambient temperature. This could lead to trouble if no visual or aural danger signal were given.

US Gauge studied the need and came up with two solutions—two USG Transformer Gauges. One solution—the USG oil-filled transformer gauge, is so constructed that oil dampens vibration from the transformer making it possible to mount the gauge directly upon the transformer. Vibration which might cause an ordinary compound gauge to fail will not affect this instrument.

The other answer—the USG Transformer Compound Alarm Gauge is capable of being hooked up to any of the warning signals currently available. It provides unusually accurate indication and low switching differentials for a gauge with such low pressure limits.

If you are interested in the health of your transformer, you will want us to forward full details on these Transformer Alarm Gauges. If, however, you are more interested in the way USG approaches an instrumentation problem—your problem—get in touch with United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pennsylvania, and let our Engineering and Production "know how" assist you.

USG creative instrumentation produced this exclusive 3½" oil-filled Transformer Gauge shown above. Oil dampens vibration, permits direct attachment of gauge to transformer. Case actually "breathes", eliminating "barometer effect".

You are looking at the USG 3½" Transformer Alarm Gauge. Note the easily-readable dial and connections for hooking in a signalling system. Separate diaphragms for operating pointer and switches eliminate friction errors.

Quality Gauges Engineered for Enduring Accuracy

UNITED STATES GAUGE

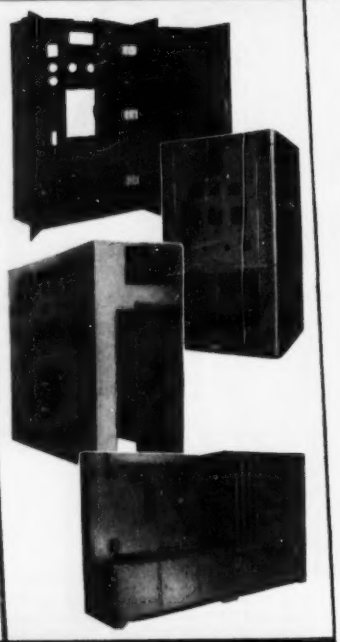
USG

PRODUCTS OF UNITED STATES GAUGE... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS

For more information circle **43** on inquiry card.

FOR ACCURATE FABRICATION of CUBICLES, CABINETS, PANEL BOARDS, see LITTLEFORD



Manufacturers of Electrical and Hydraulic Control equipment must have accuracy in the fabrication of Cubicles, Cabinets, Control Boards and Panel Boards. Accuracy comes through experience in knowing how to shear, bend, form and weld plate and sheet metals. Littleford has that experience, plus skilled craftsmen, as industry has been served by Littleford since 1882.

These long years of producing fabricated products reflect in the finished unit. Littleford facilities are modern and afford an unprecedented standard of dependability and quality. If you have a problem involving accurate fabrication remember there is no substitute for experience, and no substitute for Littleford workmanship.

Send blueprints and be assured of quality at low cost.

FABRICATORS OF PLATE AND SHEET METAL PRODUCTS FOR INDUSTRY SINCE 1882

LITTLEFORD

LITTLEFORD BROS., INC.
404 E. Pearl St.
Cincinnati 2, Ohio

For more information circle **44** on inquiry card.

NEW INSTRUMENTS

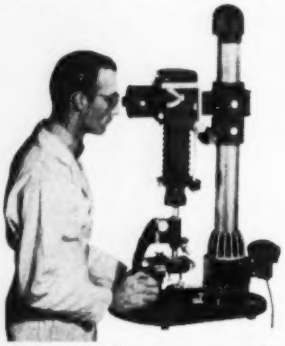
valves; can be mounted in any attitude. Three sizes, for flow ranges of 0.5 to 5, 1-15 and 6-80 gpm. Percentage-type scale is furnished as well as a specific-gravity correction-factor tag when liquids other than water are being metered. Operates at 5-psi. pressure loss across valve but can be adapted to low-pressure-drop service by removing one of its two springs.—*Fischer & Porter Co., 17 Jacksonville Rd., Hatboro, Pa.*

For more information circle **244** on inquiry card.

MICROSCOPES

Microscope Camera and Controlled Light Source

New "Orthophot" is an integrated reflex camera and controlled light source for use with any standard microscope. Camera unit swings back for



visual use of microscope, permits not only laboratory photography but photocopying, clinical photography, enlarging, and micro-projection; is adaptable for cine-photomicrography. —*Silge & Kuhne, 16th & Carolina Sts., San Francisco, Calif.*

For more information circle **245** on inquiry card.

Metallurgical Microscope

New "Reichert Research Camera Microscope MeF" for metallurgical laboratories is an Austrian-made desk-type instrument with interchangeable monocular and binocular body tubes and built-in 4x5 camera. Among features: magnifications from 4.5 to 2200; all illuminations including dual light; choice of achromatic and fluorite objectives.—*William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.*

For more information circle **246** on inquiry card.

Microscope Illuminator

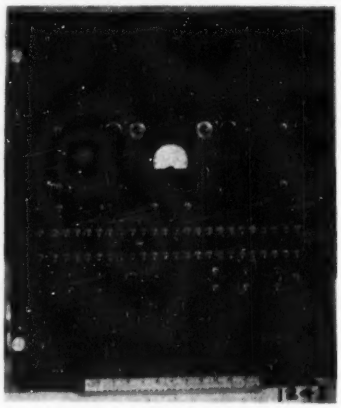
New "VBM" lamp features variable intensity for Binocular and Monocular microscopes.—*Lindly & Co., 248 Hericks Rd., Mineola, L.I., N. Y.*

For more information circle **247** on inquiry card.

COMPUTING

Electronic Computers

Two new high-speed electronic digital computers are said to be "unsurpassed in speed, amazingly small, usable for computation and as robot controllers." (1) JAINCOMP-C" (illustrated) handles numbers having 24 binary digits, can add two such numbers in 8 microseconds. Feature is its ability to both sense and control its environment: it has nine variable (primary-element) inputs and three



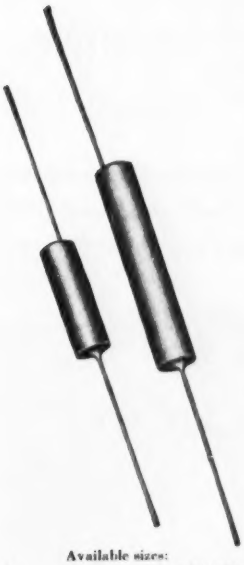
variable outputs. Ten times per second, it senses these nine inputs, computes the interrelationships of these inputs and of 70 constants (which it reads off punched cards) and controls three external devices. ★ (2) "JAINCOMP-D" is said to have as much memory capacity as many "giant brains" and to be "more versatile than any computer in existence, . . . sufficiently small and light to be airborne." It can be programmed by magnetic tape, or by an electronically-scanned punched card, or from its own memory. It is capable of modifying its own instructions.—*The Jacobs Instrument Co., Bethesda 14, Md.*

For more information circle **248** on inquiry card.

Digital Computer

New "ALWAC" (Axel L. Wenner-Gren Automatic Computer), said to "do the work of a million-dollar computer yet costs only 5 percent as much," is a serial binary computer with internally programmed magnetic drum; consists of an arithmetic unit, memory unit, control unit, and input-output sections; features a rotating magnetic drum memory of 2048-word main storage capacity with a number of reading and writing heads mounted in near-contact with surface of cyl-

QUALITY CAN COST LESS



Available sizes:
4 watt.....1 to 1000 ohms
$\frac{5}{16}$" dia. x 1" long
7 watt.....1 to 5000 ohms
$\frac{5}{16}$" dia. x 1$\frac{3}{4}$" long
Standard Tolerance.....10%

...And MALLORY Ceramic Resistors Prove It!

Wherever you need fixed resistors in television and other electronic circuits, you can get an ideal combination of quality and economy in Mallory Ceramic Resistors. They're low in cost—and their axial lead construction cuts production expense by eliminating mounting brackets, permitting point-to-point wiring and saving under-chassis space.

These features assure top quality performance:

- ***Accurate resistance up to rated wattage through the use of exclusive Mallory Yard-Ohm wire.***
- ***Long life: Fiberglas core contains no organic materials: high grade non-corrosive inorganic cement, injected under pressure to give high heat dissipation, holds resistance element securely. Resistors are built to take 100% overloads.***
- ***Moisture protection: Resistor ends are sealed by special heat and moisture resistant compound.***
- ***Rugged construction: tinned leads are securely clinched to prevent opens, high resistance and pull-outs. Non-porous steatite tubes protect against mechanical and thermal shock.***

For complete facts, write for the new catalog on fixed wire-wound resistors and carbon and wire-wound controls.

NEW 25-WATT RHEOSTAT

A line of wire-wound rheostats, with ranges from 1 to 2500 ohms, is now available. A patented hinged-spring contact arm provides smooth rotation and assures correct, constant pressure against the winding. Write for information.

Expect more . . . Get more from MALLORY

Parts distributors in all major cities stock Mallory standard components for your convenience

P. R. MALLORY & CO. Inc.
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P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

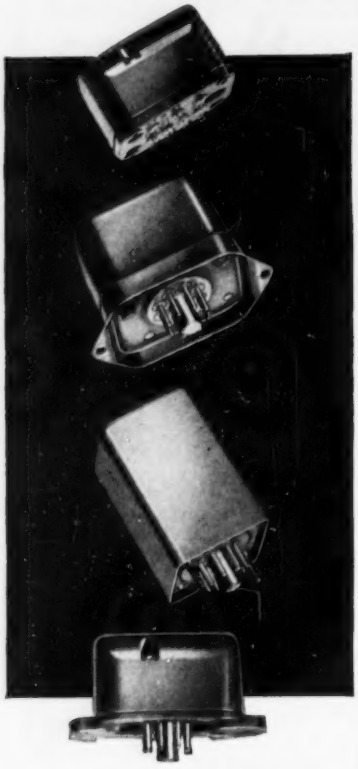
Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

For more information circle **45** on inquiry card.

BARBER COLMAN

ultra-sensitive relays

eliminate need for vacuum tubes in many electronic, servomechanical and photoelectric circuits



...in sensitivities ranging from 50 microwatts to 1 milliwatt

Ideal for hundreds of industrial applications, Barber-Colman "Micro-positioner" d-c polarized relays are extremely sensitive, stable, and vibration resistant. High-speed response—can be operated in excess of 100 cps. Available in a wide range of coils, enclosures and mounting details. Extensively used in balance-detecting bridge circuits and as plate current relays in electronic applications.

Write today for Bulletin F3961-2

BARBER-COLMAN COMPANY,

Dept. B, 1415 Rock St., Rockford, Illinois

For more information circle **46** on inquiry card.

NEW INSTRUMENTS

inder. Basic commands are put into machine, and answers obtained from it, on electric typewriters and paper-tape-perforating and tape-reading equipment.—*Logistics Research, Inc., Redondo Beach, Calif.*

For more information circle **249** on inquiry card.

Graphic-record Digitizer

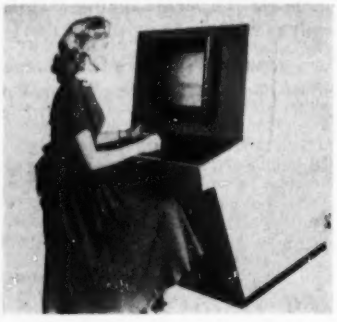
New "Contact Telereader" measures film and oscillograph records by means of rapid cross-wire motion, "many times faster than is possible

by manual methods," with an accuracy of 0.01 in.; handles single sheet or roll records of any length and any width up to 18 in. Measurements can be made between a trace and base line, between two traces, or peak-to-peak on oscillatory traces. Linear or non-linear calibrations can be applied electronically or graphically. Ordinates, (calibrated or uncalibrated) can also be accumulated to provide mean values or areas.—*Telecomputing Corp., Burbank, Calif.*

For more information circle **250** on inquiry card.

Data-reduction Machine

New "Boscar" is said to represent a radical departure from orthodox film reading devices in that cross-wires, gears, etc., have been replaced

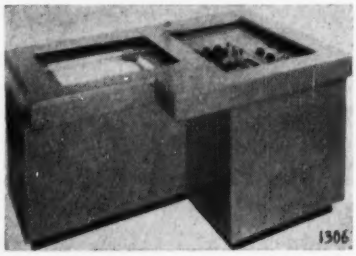


by a fingertip stick controlling a flying spot, so that operator has a feeling of pointing at object on screen whose position is to be measured. "Boscar" automatically measures *X-Y* displacement of image and provides an output for direct application to maker's Electroplotter, Decimal Converter and Electrotyper, or to punched-card machines, etc.—*Benson-Lehner Corp.*, 2340 *BA Sawtelle Blvd., West Los Angeles* 64, *Calif.*

For more information circle **251** on inquiry card.

Automatic Plotter

New "Electroplotter" plots on paper up to 11x17 in. (larger sizes available) from input sources such as computers, punched-card machines or manual

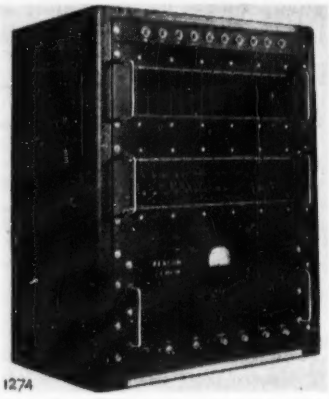


keyboard. In latter case, a high-speed ten-key keyboard with numerical verifier provides for plotting rates at about 35 points per minute. Pen traversing speed, 18 in./sec.; accuracy, 0.1 percent. Among features: automatic symbol printing, independent zero and scale controls for each axis, selectable incremental advance when required, and vacuum table for holding paper.—*Benson-Lehner Corp.*, 2340 *EA Sawtelle Blvd., W. Los Angeles* 64, *Calif.*

For more information circle **252** on inquiry card.

Instrument Data Converter

New "Reacon" automatic high-speed analog-to-digital converter for firms, institutions, etc., with instrument data handling problems, is not



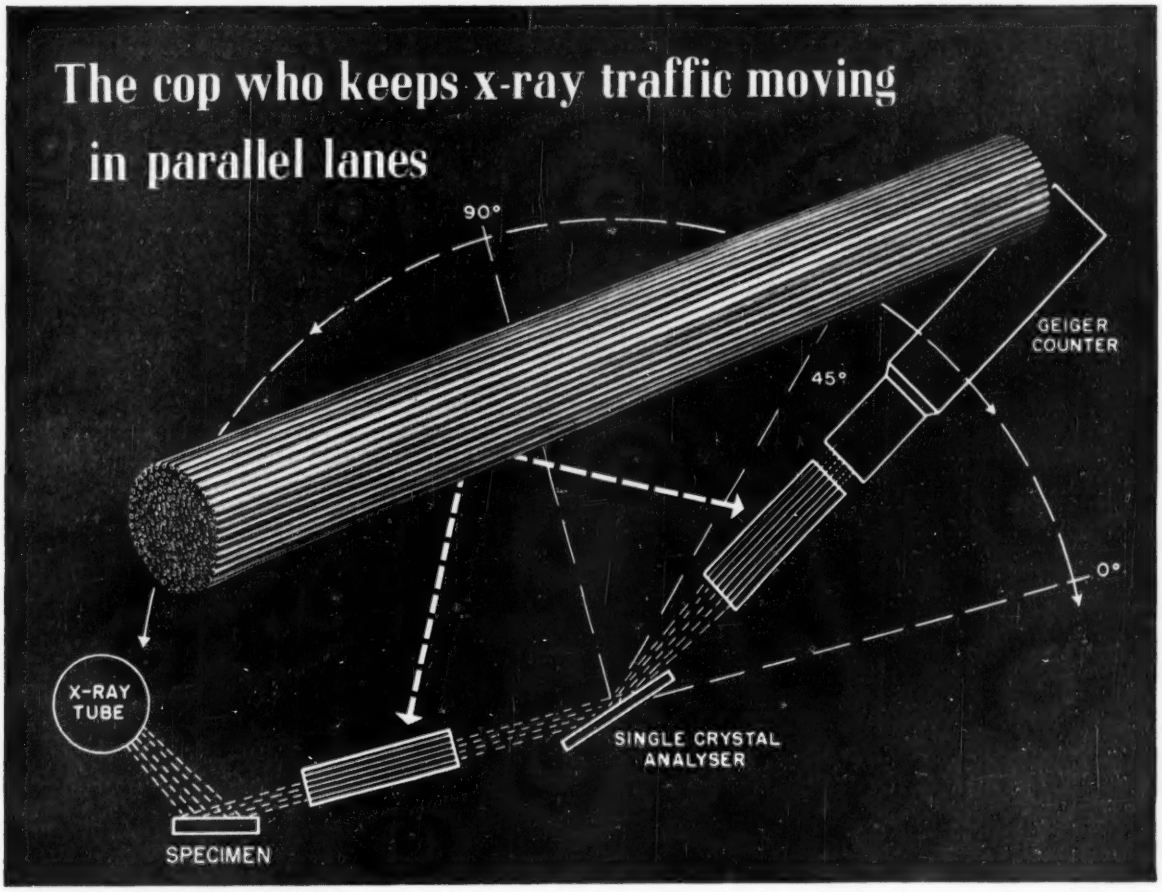
an off-the-shelf item but is designed for specific applications, taking into consideration type of inputs and outputs, speed of handling, quantity of data, etc. It operates with inputs directly from strain gages, thermocouples, etc. Proportional digital output count recorded at 8,000 bits per second from a continuous channel or at 640 bits per second from a number of pickups sampled in sequence. Information can be taken at intervals selected manually or at pre-selected intervals from an intervalometer.—*J. B. Rea Co.*, 1723 *Cloverfield Blvd., Santa Monica, Calif.*

For more information circle **253** on inquiry card.

Counting Decade

New "SC-41 Plug-In Decascale" is a direct-reading electronic counter capable of operating at 75,000 counts-per-second and resolving individual

The cop who keeps x-ray traffic moving in parallel lanes



Fluorescence analysis is the new, fast way to find out which elements and how much of each are in alloys—without destroying the sample of the alloy.

This trick is accomplished by bombarding the alloy specimen with X-rays using a Fluorescence Analysis Unit produced by North American Philips, Inc. The x-radiations of each element bounce off the specimen only to be separated according to wavelength and measured.

As the x-radiations leave the specimen they shoot through bundles of fine tubes known as "collimators". The collimator acts as a kind of traffic cop, keeps the rays moving in parallel lanes, reduces divergence. This is an interesting job, and we're pleased that North American Philips chose Superior fine nickel tubing for it on the basis of its uniformity in diameter, wall thickness and finish.

Undoubtedly you have opportunities where tubing could be helpful—as a carrier, a weight-saving structural member, or as a shape that saves machining time. Look into the variety of forms, sizes, and analyses Superior produces to tight specifications. Take advantage of the experience and testing facilities that Superior brings to focus on your problem. Tell us the nature of your application and we'll send you information and a Data Memo by return mail. Superior Tube Company, 1968 Germantown Ave., Norristown, Pa.

Round and Shaped Tubing available in Carbon, Alloy, and Stainless Steels, Nickel Alloys, Beryllium Copper, Titanium and Zirconium.

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All analyses .010" to ⅝" O.D.
Certain analyses (.035" Max. wall) up to 1⅜" O.D.

For more information circle **47** on inquiry card.

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SPIRALPOT

POTENTIOMETERS

Precision slide-wire potentiometers that meet your most exacting demands with ±0.025%, ±0.05%, ±0.1% linearity—zero based • Infinite resolution • Positive stops without backlash • Resistance from 2 to 25,000 ohms • 1 to 40 shaft turns • Close rotational toleran :es • Long life and low noise.

With ±0.01% normal linearity when requested
1 to 15 turns—360° to 5400°
Weighs 4 oz., Resistances—2 to 3,750 ohms ±5%; 250 ohms/360° max.
Torque—starting 0.6 oz. in.; running 0.2 oz. in.

20 to 40 turns—
7,200° to 14,400°—Weighs 5 oz.
Resistances—40 to 10,000 ohms ±5%; 250 ohms/360° max.
Torque—starting 0.6 oz. in.; running 0.3 oz. in.

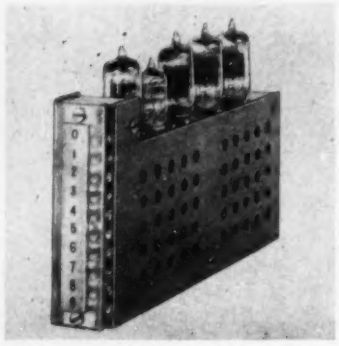
1 to 40 turns—
360° to 14,400°—
Weighs 10 oz., Resistances—5 to 25,000 ohms ±5%; 625 ohms/360° max. Torque—starting 1.0 oz. in.; running 0.5 oz. in.

Giannini

Special problem? Further information? Please write:
G. M. GIANNINI & CO., INC.
Electro Mechanical Division
East Orange, New Jersey

For more information circle **48** on inquiry card.

NEW INSTRUMENTS



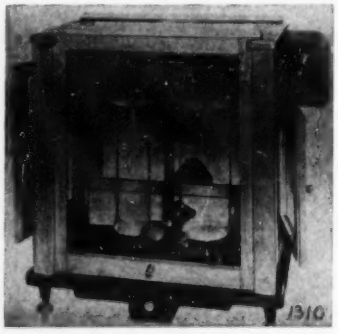
pulses separated by as little as 5 microseconds. It has a 5-tube decade scaling unit with a self-contained ten-light neon indicator. Ten-count output pulse may be applied to input of a following "Decascale," or to other devices. Input pulse ranges is from 75 to 100 volts negative with a rise-time of 1 usec. or less. Output pulses are 100-v. negative at count of 10, with 100-v. positive pulses available at counts of 2, 4, 6, and 10 for special uses.—*Tracerlab Inc.*, 130 *High St., Boston* 10, *Mass.*

For more information circle **254** on inquiry card.

FOR THE LABORATORY

Laboratory Balances

New "Stanton" laboratory balances (English-made) feature damping cylinders which arrest beam rapidly, and planes of synthetic sapphire which



provide uniformly hard surface for maintained sensitivity. Models include an automatic loading aperiodic balance with immediate totaling of weights; an aperiodic projected-reading balance for routine laboratory service; a model for rapid routine weighings; and an advanced design in a microchemical aperiodic projected-reading balance.—*The Burrell Corp.*, 2223 *Fifth Ave., Pittsburgh, Pa.*

For more information circle **255** on inquiry card.

Polyethylene Sink Unit

New "Lanco" all-polyethylene sink unit is dent-proof, break-proof, chemical and acid-resistant, and may be installed easily on any laboratory sink. It consists of: stopper, high-level drain, strainer, lock-nut, plug, trap, and outlet union. Feature is trap, which anyone can remove, empty, rinse and replace in a matter of seconds without tools.—*Arthur S. LaPine & Co.*, 6001 *S. Knox Ave., Chicago* 29, *Ill.*

For more information circle **256** on inquiry card.

Laboratory Marking Pen

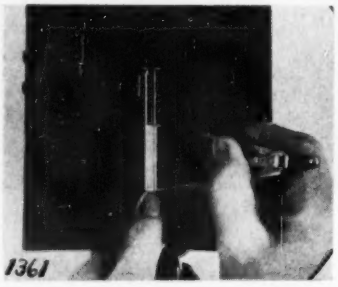
New "Tech-Pen" all-purpose laboratory marking pen writes clearly on any surface with opaque quick-drying ink; has no felt tip; has no

parts requiring replacement; comes with extra ink supply sufficient for 25,000 markings. Markings resist effects of temperature changes, weather, and most chemicals; are removed by a common solvent such as carbon tet or toluol.—*Mark-Tex Corp.*, 453 *W. 17th St., New York* 11, *N. Y.*

For more information circle **257** on inquiry card.

UV Illuminator for Babcock Test

New "Model 1034 Voglo Black Light Babcock Reader" employs a source of ultraviolet especially developed for making fat column fluoresce brightly.



Both cream and milk types of Babcock tubes can be read. Top and bottom menisci are made clearly visible in daylight, doing away with variations in results by different operators or by one operator under different illuminations.—*Vogel Luminescence Corp.*, 925 *Harrison St., San Francisco* 7, *Calif.*

For more information circle **258** on inquiry card.

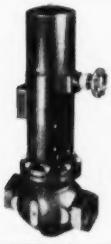
Laboratory Evaporator

New "Epiradiator," for evaporation of liquids in laboratory work, does not induce evaporation by boiling: instead, surface of liquid is subjected

for better automatic controls **GENERAL CONTROLS** *check*

For reliable, automatic control of your product or process . . . whether it is in a heating, refrigeration, industrial or aircraft application . . . General Controls automatic controls will provide dependable, low cost, trouble free performance. Send for a copy of Catalog 53G . . . on your company letterhead, please.

B-55G Governor Type Gas Valve for on-off, high-low modulating and air damper control. Slow opening diaphragm. For gas-flow to industrial boilers and furnaces.



V-110 Electro-Magnetic Valve for gas- and oil-fired boilers. Electro-magnetic trip mechanism prevents flow until current is supplied. Positive safety shutoff.

K-21 Magnetic Stop Valve for liquid and gas. Humless. Coil variations for many temperature and flow requirements. Positive safety shut-off. Valve closes with flow.

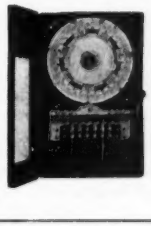
Hydramotor Valve. Screwed type valve body. Fast acting actuator; positive shut-off in ½ to 2 seconds. H-Series actuators available in speeds for every application.

Hydramotor. ac two-wire actuator with specially designed electro-hydraulic pump. Provides reliable normally-open or normally-closed service for gas or fluid control.

Air Motor Valve. Air-opening and closing diaphragm actuators. For modulating control with valve positioners, timers or other instruments for high accuracy flow control.

L-59T Refrigeration Temperature Control. Designed for industrial applications to control magnetic or motor-operated valves, heating or cooling units, relays, etc.

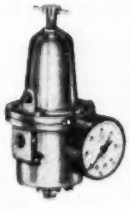
Electronic bridge, signalling type temperature controller. No batteries or moving parts. Excellent performance, high sensitivity with minimum maintenance.



Program Timer, powered by electric or spring-wound clock. Controls daily or weekly operations. Maximum 12 operations a day; 18 minute "off" period.

Pneumatic Indicator in cast aluminum case. Assemblies interchangeable. One of General Controls' wide line of pneumatic indicators, recorders and controllers.

K-15 Magnetic Piloted Piston Valve for gas and liquid control. Large flow capacity, humless and fail-safe. Available in 3 coil, and 5 seat variations.



V-301 and V-302 Pneumatic Pressure Regulators are designed to reduce line pressures up to 150 psi to working pressures of 0-30, 0-60, or 0-100 psi.

K-13 Series 3-Way Packless Magnetic Valves. Solenoid operated, two-wire, current failure type. Designed to control fluids to piston and diaphragm operators.

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Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls for Heating, Home Appliances, Refrigeration, Industrial and Aircraft Applications.

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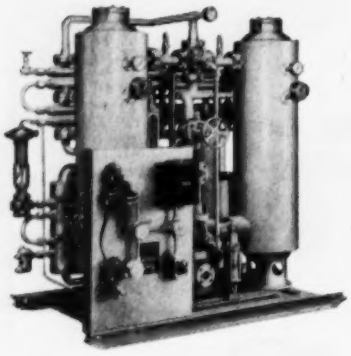
For more information circle 49 on inquiry card.

Pritchard
HYDRYER



IT ELIMINATES
MOISTURE PROBLEMS

This dependable Pritchard dehydration unit—a packaged dryer proved efficient in all types of industrial, processing and laboratory installations—reduces moisture content of air or other gases to desired dew points. That eliminates a lot of your moisture problems . . . gives you a good reason for owning a HYDRYER*. There are other good reasons, all of which will save you money.

Here are examples: A HYDRYER will eliminate costly plant and equipment shutdowns due to moisture and ice; it will protect precision instruments and controls; it will reduce corrosion, line losses, flow stoppages.

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COOLING TOWERS • SPECIALIZED HEAT EXCHANGERS • GAS & AIR TREATING EQUIPMENT

For more information circle **50** on inquiry card.

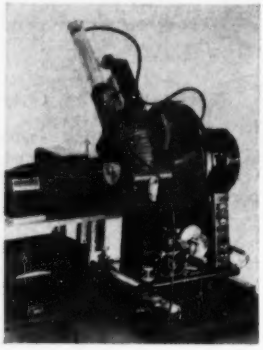
NEW INSTRUMENTS

to calorific radiation; energy is absorbed by surface layer, thereby producing evaporation while remainder of liquid and vessel itself remain relatively cold. This method is said to insure "a clean and perfect residue." Units are made of fused silica; are acid resistant; come in four sizes for operation on 110 or 220 volts.—*Quartz Products Corp., 25 Crowsmill Road, Keasbey, N. J.*

For more information circle **259** on inquiry card.

Helium Attachment for X-ray Spectrograph

New attachment for maker's x-ray spectrograph units permits use of helium instead of air in path of x-ray beam. Work now extends down to sulphur (atomic number 16). Consideration of results obtained indicates a probable sensitivity limit 0.02 percent for sulphur, with comparable sensitivity limits for other elements in same atomic range.—*Research & Control Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.*



For more information circle **260** on inquiry card.

Densitometer Calibrator

New astronomical calibration tube was designed for greater accuracy in star measurement through calibration of density of photographic negatives. In operation a motor-driven sector exposes photographic plate to light passed through various diffraction filters of known wavelength.—*L. C. Eichner Instruments, 19 Sebago St., Clifton, N. J.*

For more information circle **261** on inquiry card.

Multiplier Phototubes

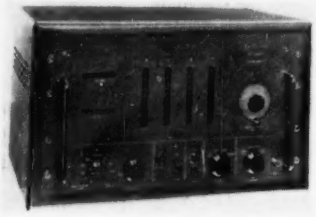
New "6342" is a head-on type of vacuum multiplier phototube designed to be used in scintillation counters. It has relative freedom from afterpulses, and small spread in electron-transit time. Design features include a 1½-in.-diam. semi-transparent cathode; a flat face to facilitate mounting flat phosphor crystals; ten electrostatically-focused dynode stages; and a focusing electrode with external connection. ★ New "6328" is a short multiplier phototube of 9-stage type for use in automobile headlight-dimming service, etc.—*Tube Dep't. Radio Corporation of America, Harrison, N. J.*

For more information circle **262** on inquiry card.

NUCLEONICS

Automatic Scaling Unit

New "Model 2200 Automatic Scaling Unit" is a high-speed (100,000/-sec.) counting instrument for automatic counting of electrical pulses obtained from nuclear particle detection equipment. It comprises an input pulse height discriminator, an electronic scaling channel with 1-usec. paired pulse resolution, mechanical register, time clock, and automatic control circuitry. Other features: electronic scale of 10,000, predetermined count, predetermined time and motor-driven reset.—*Berkeley Scientific Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.*



For more information circle **263** on inquiry card.

Carbon-14 Assay Apparatus

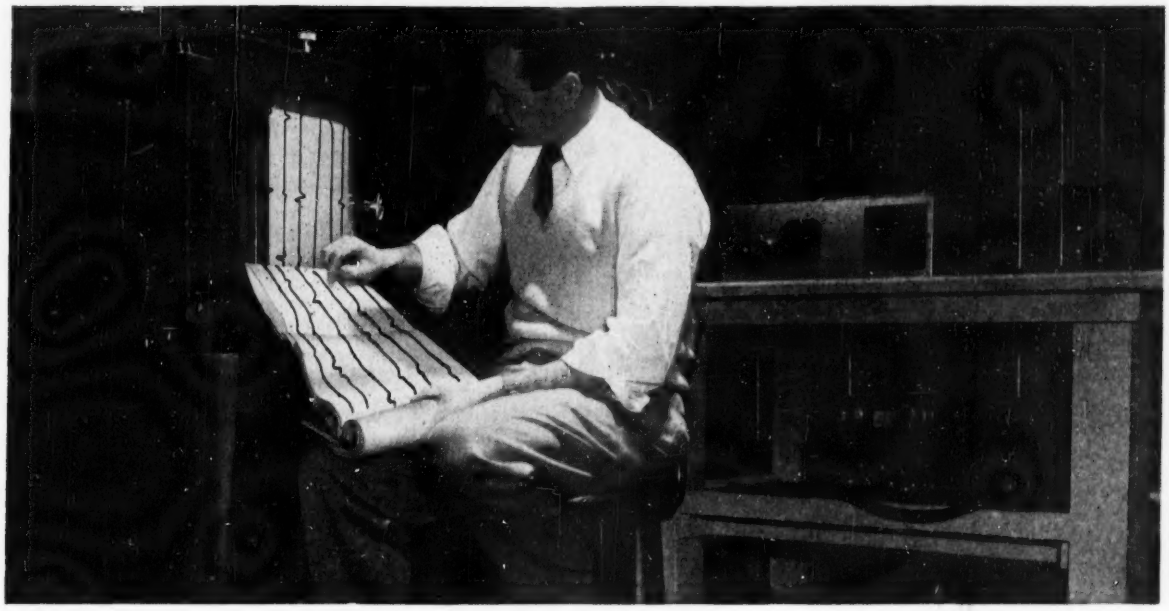
New apparatus for assay of radioactive carbon-14 by Van Slyke-Steel procedure is said to have advantages over counting solid barium carbonate samples: (1) for a given sample size, measurements of lower specific activities are possible; (2) over-all sensitivity is greater since counting losses due to window, air, or self-absorption are avoided. Count is proportional to sample size over entire range (0.1 to 15 mg.) of the combustion.—*Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.*

For more information circle **264** on inquiry card.

Alpha-Beta Monitor

New "Model L-76 Radicond" is a quartz-fiber instrument which measures alpha and beta rays over intensities down to a fraction of radioactive background. Built-in timer removes need for a stopwatch; timer stops fiber image on reticle of microscope, facilitating readings. Instrument was designed especially to make field measurements, particularly of contamination of food and water. Timer can be set so that beta contamination of food

Brush six-channel magnetic oscillograph used to record output of an analog computer, which duplicates flight conditions for a jet plane. Photo courtesy Sperry Gyroscope Company.



MULTI-CHANNEL OSCILLOGRAPHS

Brush instruments reduce your engineering costs

Simultaneous recording of several electrical or mechanical phenomena with Brush multi-channel oscillographs *saves engineering time and simplifies your testing.* These precision instruments give you immediate answers in writing—stress, strain, torque, vibration, pressure, flow, electrical characteristics, and other variables.

For complete description of time-saving Brush instruments, ask your nearby Brush representative to call . . .
or write for your copy of "Modern Measurements."
Brush Electronics Company, Department A-2,
3405 Perkins Avenue, Cleveland 14, Ohio.

New portable six-channel oscillograph simplifies recording of phenomena in the shop or in the field. Instrument is lightweight, self-contained, and easy to use.

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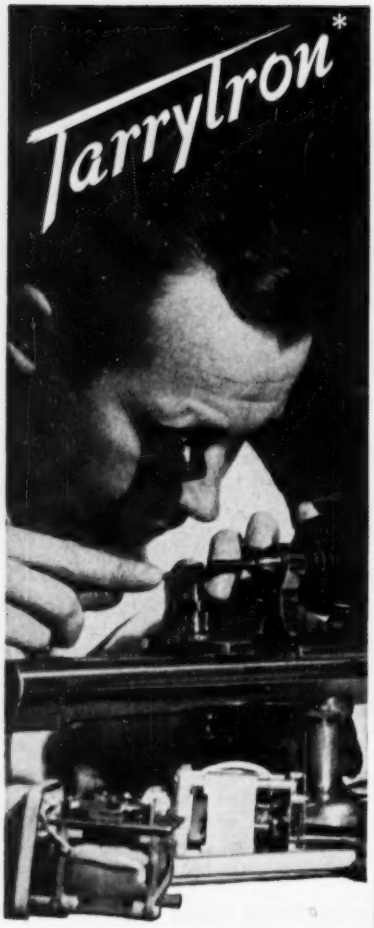
For more information circle **51** on inquiry card.



* TARRYTRON TIME DELAYS by Diaphlex have introduced new techniques and standards in the art of measuring time increments for controlling the sequencing, programming, actuating, and deferring of aircraft and missile component operations.

* TARRYTRON TIME DELAYS employing the exclusive Rock Shaft Motion require fine instrument technology, the watchmaker's art, and the most advanced engineering standards to perform satisfactorily.

* TARRYTRON TIME DELAYS operate in the range from one tenth to ninety seconds (±15%) when subjected to temperature (−65°F to +200°F) and vibration extremes, high impact, a wide range of environmental conditions and when positioned in any attitude.

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For more information circle **52** on inquiry card.

NEW INSTRUMENTS

and water by fission products can be read directly in terms of acceptable 10-day or 30-day emergency levels. Samples in container slide into position below ionization chamber.—*Landsverk Electrometer Co.*, 550 *W. Garfield Ave., Glendale* 4, *Calif.*

For more information circle **265** on inquiry card.

Set-count or Set-time Scaler

New "Model 183" scaler for use with Geiger or scintillation counters features controls to allow operation for a predetermined number of counts

or a predetermined length of time; may be used in conjunction with maker's "Model C-110" sample changer for completely automatic counting of up to 50 radioactive samples. Higinbotham scale of 256 and 2-usec. resolving time; scale selector and "count-o-matic" operation switch of 10, 100, or 1000 times scaling factor. External "Model T1" timer for predetermined time operation. Built-in elapsed-time indicator to 9999.99 minutes.—*Nuclear Instrument and Chemical Corp.*, 229 *W. Erie St., Chicago* 10, *Ill.*

For more information circle **266** on inquiry card.

Integrating Ratemeter

New "Model 575 Radocon" uses various thimble ionization chambers for measurement, in roentgens, of both rate and total dose. Standard probe covers energies of 30 to 400 kev, 1 to 999 roentgens total dose in 1-r. steps, and intensities of 1-100-r./min. in three ranges: 0/10/30/100. Radiation energies from 30 kev. to 2 Mev. are covered with chambers calibrated in

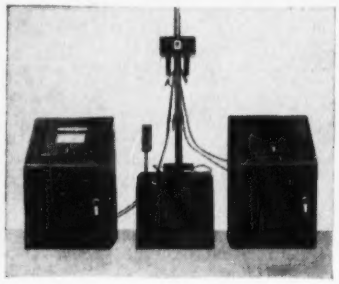
roentgens; experimental chambers extend this to 100 Mev. Probes for measuring total dose and intensities as much as a thousand times higher and lower than those of standard probe are available.—*Victoreen Instrument Co.*, 3800 *Perkins Ave., Cleveland* 14, *Ohio.*

For more information circle **267** on inquiry card.

FOR INSPECTION AND TESTING DEPARTMENT

Tube-thickness Beta Gage

New gage utilizes beta rays from a radioactive source to measure wall thickness and roundness of tubing; is said to provide a means, "never be-

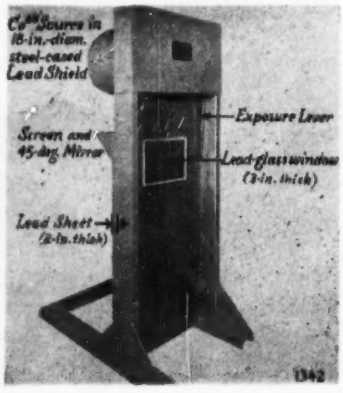


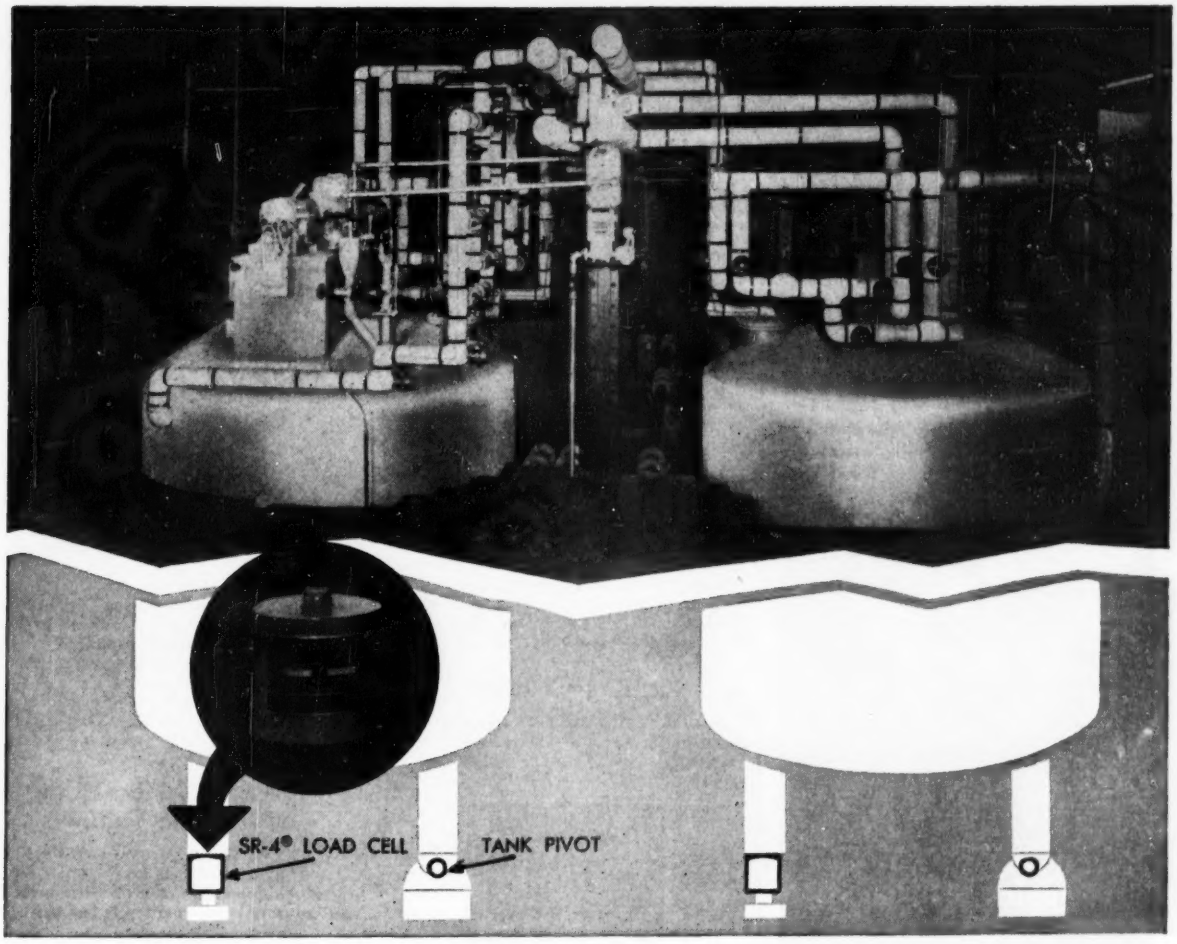
fore available," of gaging small-diameter thin-walled tubing "with extreme accuracy." A source of beta radiation is moved inside the tube in relation to a detector outside the tube. Changes in wall thickness are shown by means of a trace on a recorder chart.—*Tracerlab Inc.*, 130 *High St., Boston* 10, *Mass.*

For more information circle **268** on inquiry card.

Gamma-ray Fluoroscope

New "Raychronix" fluoroscope for non-destructive inspection of parts and assemblies utilizes a 4-watt cobalt-60 source of gamma rays; is so arranged that a conveyor belt can pass between bottom opening of source-shield and 12x12-in. fluoroscopic screen. Illustration shows basic machine, does not show belt, side shields, etc., that would vary with individual installation. Machine is not sold but leased. Among advantages of leasing: (1) responsibility for safe handling of Co^{60} is lessor's; (2) operator need





Baldwin SR-4® Load Cells Permit Remote and Automatic Control of Latex "Batching"

THE PROBLEM:

In order to weigh liquid latex directly in the processing tanks, this leading rubber company sought a method which would require very little head room, use a minimum of steel and control various steps of each batch with ½ of 1% accuracy.

THE BALDWIN SOLUTION:

Every requirement was met by the installation of a Baldwin SR-4 weighing system. Each 2,000 gal. tank, holding 16,000 pounds of latex, is supported by three legs. Two of the legs have rod-end bearings and the third rests on one 10,000 pound SR-4 Type C Load Cell. As the tank fills, changes in its weight are transmitted by electric cables from the cells to a switching unit and an indicator-controller on the upper floor.

This system offers these benefits:

• It controls automatically the entire batching operation, providing lights and alarms for empty and full conditions of the tank. It also has adjustable controls between empty and full for sizing each particular batch by controlling motorized valves.

• The SR-4 system made it unnecessary to use much steel during installation. The small size of the load cells meant that the available headroom (14 inches) was ample.

• The SR-4 Cells' rugged construction and absence of moving parts, combined with good instrumentation and proper engineering, have enabled this system to maintain constantly its inherent accuracy of ¼ of 1% of capacity.

• Due to the electrical nature of SR-4 cells, they could be located on one floor and the indicating-controlling instrument on another.

SR-4 Devices in Industry... Uses Unlimited

For measuring load, fluid pressure, or torque more accurately and economically Baldwin SR-4 devices have *unlimited uses* in industry. Write for our two new booklets on tank weighing (No. 4106) and crane scales (No. 4105). Address: Dept. 3115 Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.

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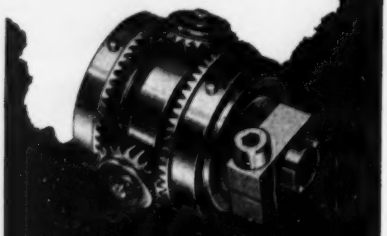
For more information circle **53** on inquiry card.

Hollow Shaft Differential

Minimum weight, inertia, and backlash. A precision computer component. Designed for accurate resolution of angular position or velocity sums and differences. Hollow shaft design offers complete freedom of positioning of differential on shaft and facilitates installation-removal of differential from shaft without instrument disassembly. Shrink-on, safety-keyed side gears available to your specifications. Inertia: .0745 ounce-inch^2; maximum backlash: 10′; overall axial length: 1 3/16″; clearance radius: .520″; weight: 1¼ ounces; unit receives a 3/16″ diameter shaft. Precision ball bearings.



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For more information circle **54** on inquiry card.

not be an x-ray technician; (3) lessee's personnel have no need (and are forbidden) to open machine.—*Radioactive Products, Inc., 443 W. Congress, Detroit 26, Mich.*

For more information circle **269** on inquiry card.

Ultrasonic Probes

New "Type B Transducers" are ½-in.-diam. crystal probes for use with maker's "Audigage" ultrasonic thickness testers; make possible thickness measurements on metal of sharply-tapering section, compound curvatures, and other unusual conformations previously impossible to measure accurately. They have a sensitivity approx. equal to that of conventional 1⅜-in. diam. all-quartz probes.—*Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.*

For more information circle **270** on inquiry card.

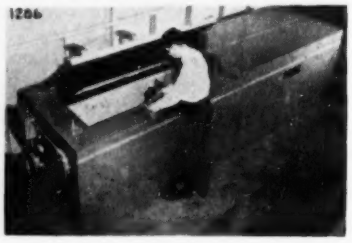
Chilling Chambers

New freezing cabinets are available in sizes from 2 to 20 cu. ft., with standard power units to produce either −70 F. or −120 F., from 110- or 220-v.ac. single-phase, and 220- or 440-v.ac. 3-phase, as specified by user. Cabinet insulation is Fiberglas or Santocel moisture-vapor-proof sealed in position. Glass viewing ports and access ports available.—*Mede Corp., P. O. Box 754, Highland Park, Ill.*

For more information circle **271** on inquiry card.

Low-temperature Chambers

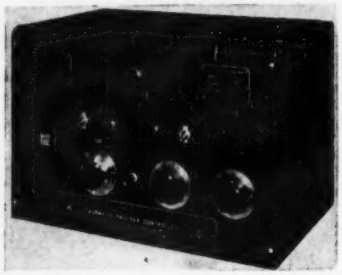
New series of five standard sizes is announced for "Sub-Arctic" line of low-temperature industrial chambers. Sizes (1, 4, 6, 9 and 12 cu. ft.) were selected to cover most industrial needs and to eliminate premium costs of custom-built models. Chambers are designed for operation at −40, −80, −100, −120, −150, and −170 F.; can be equipped with program controls which automatically cycle temperatures according to pre-set patterns.—*Tenney Engineering Inc., 26 Avenue B, Newark 5, N. J.*



For more information circle **272** on inquiry card.

Testing Program Controllers

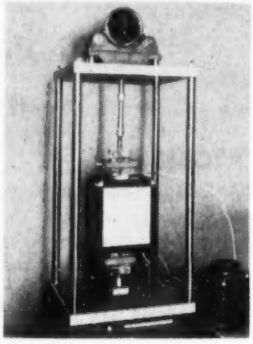
New "Automatic Testing Program Controllers" have been designed for production testing, proof testing, yield strength by extension under load method, stress cycling (load), strain (unit deformation) cycling and crosshead cycling. Units are available for any one or any combination of these automatic testing control functions. Illustration shows composite unit.—*Tinius Olsen Testing Machine Co., 1116 Easton Road, Willow Grove, Pa.*



For more information circle **273** on inquiry card.

Universal Testers With Temperature Cabinets

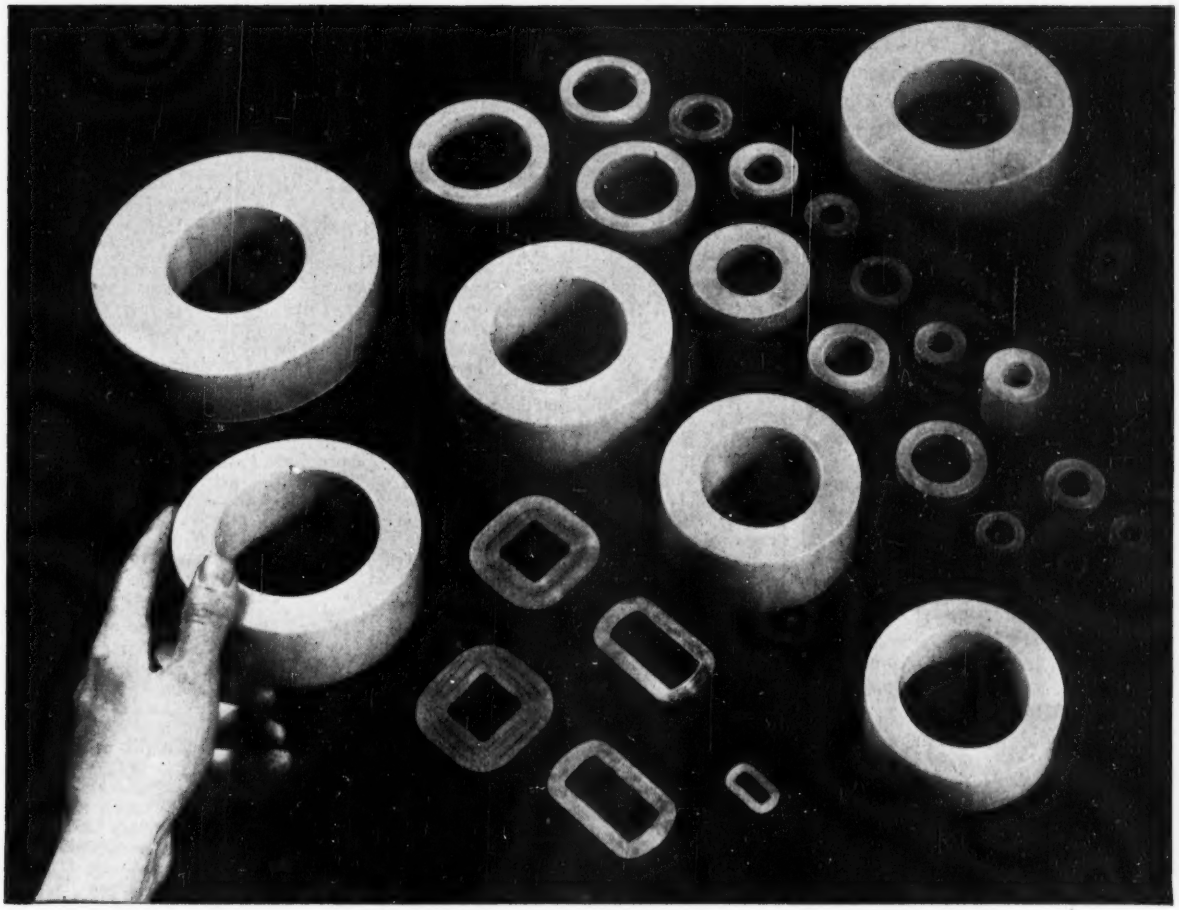
New combinations are available, consisting of maker's Universal Testing Machines (standard or with extra-tall columns) and controlled-temperature cabinets, electrically heated (or refrigerated) and equipped with automatic controllers. Machine capacities from 0-250 lbs. to 0-10,000 lbs., hand- or motor-operated; all suitable for tension, compression, transverse or shear tests. Cabinets to order.—*W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Calif.*



For more information circle **274** on inquiry card.

Potato-chip Oil Tester

New charts to be used with "Steinlite Model 300 LOS Oil Tester" permit determining oil content of potato chips by a liquid cell electronic method faster than carbon-tetrachloride method or ether-extraction method, and said to be "fully as accurate." New charts were developed in coop-



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Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 4-79 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . or SILECTRON (grain-oriented silicon steel).

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Practically any size Tape-Wound Core can be supplied, from a fraction of a gram to several hundred pounds in weight. Toroidal cores are made in twenty-two standard sizes with protective nylon cases. Special sizes of toroidal cores—and all cut cores, square or rectangular cores—are manufactured to meet your individual requirements.

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In each of the magnetic materials named, Arnold Tape-Wound Cores are produced in the following standard tape thicknesses: .012", .008", .004", .002", .001", .0005", or .00025", as required.

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Let us help with your problems of cores for Magnetic Amplifiers, Pulse Transformers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Peaking Strips, Reactors, etc.

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For more information circle **55** on inquiry card.

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Twelve inch die-cast aluminum case with black or white wrinkle or satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 +950°F or Equivalent in °C.

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Thoroughly annealed for permanent accuracy. Complete line A.S.T.M. and fractional division types.

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THERMOMETERS, INC.
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For more information circle **56** on inquiry card.

NEW INSTRUMENTS

eration with National Potato Chip Institute; cover an oil content range of 25 to 50 percent.—*Seedburo Equipment Co., 618 W. Jackson Blvd., Chicago, Ill.*

For more information circle **275** on inquiry card.

Pocket Hardness Testers

New "Sklerographs," imported pocket-size hardness testers utilizing rebound principle, are said to combine unusually low cost and simplicity of use with consistent accuracy of test results. Hardness can be read to 1 point Rockwell C; tables (supplied) permit quick conversion of its scale reading to Shore, Rockwell C, Rockwell B or Brinell. Two models: "Model M" weighs 5¼ oz. including 6½-in. container, is suitable for use by engineers and metallurgists, leaves no indentation on surface. Larger "Model D," designed to withstand rough service, weighs 9 oz.; leaves a small indentation.—*Kurt Orban Co., Inc., 205 E. 42nd St., New York 17, N. Y.*

For more information circle **276** on inquiry card.

Sheet Hardness Tester

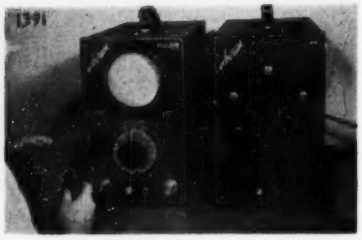
New "Model 317" sheet metal hardness tester is said to offer a precise method of testing hardness of ferrous and non-ferrous sheet metal from 0.01

in. to 0.25 in. It uses a ⅛-in. ball and 150-kg. load. By use of a calibrated microscope and reticle, readings can be obtained well within 2 points in Brinell scale. Microscope has a self-contained battery type illuminator. It is not possible to squeeze pliers too hard: a limiting pad forms all indentations with the same load.—*Pacific Transducer Corp., 11921 West Pico Boulevard, Los Angeles 64, Calif.*

For more information circle **277** on inquiry card.

Metal Sorter

New "Model C-1 Cyclograph," for non-destructive testing and sorting of accidentally-mixed or incorrectly-processed ferrous or non-ferrous



metal parts, will sort raw stock, semi-finished, or finished parts by analysis, hardness, structure, case depth, etc. With a known acceptable part used as a "standard" in adjusting instrument, unwanted parts are quickly identified. It can be used as a hand sorter (operator watches screen and manually throws out off-standard parts) or in conjunction with maker's "Type 407 Automatic Relay Unit" (parts passed through test coil on a belt conveyor, etc., for fully-automatic high-speed inspection).—*J. W. Dice Co., 1 Engle St., Englewood, N. J.*

For more information circle **278** on inquiry card.

Stiffness Tester

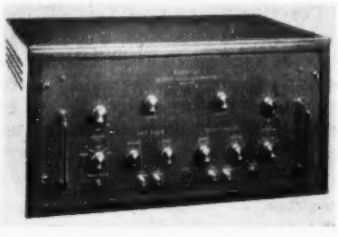
New "Model 150 Stiffness Tester," for determining initial and basic stiffness of sheet and wire specimens, is

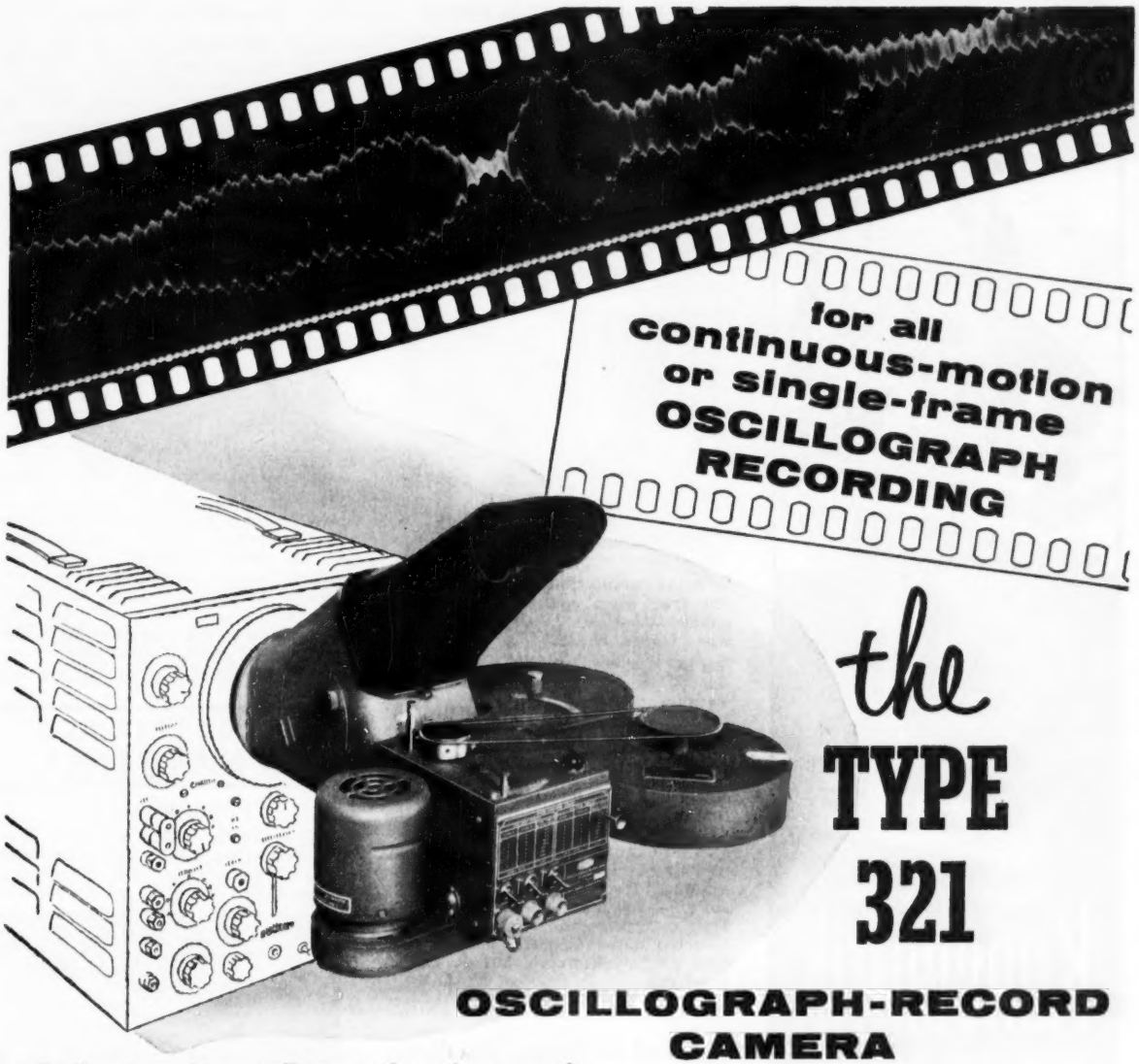
more sensitive than previous models, having eight test ranges instead of six. Flexural rigidity of such thin materials as cellophane, metal foil, synthetic fibres, etc., can be determined with "SR150-14" attachment which magnifies dial readings 100 times. Test length, angle of deflection and rate of loading are all standardized for reliable test results among different laboratories. A triple-cut shear blanks out standard-size specimens up to 20 pt. thickness.—*Section 26, Taber Instrument Corp., 111 Goundry Street, N. Tonawanda, N. Y.*

For more information circle **279** on inquiry card.

Double-pulse Generator

New "Model 4904 Double Pulse Generator" provides a source of "single" or "paired" pulses for laboratory testing of electronic pulse circuits. It comprises two basic pulse-forming circuits which are triggered at a variable repetition rate by either an internal or an external frequency source, or by a manually-operated switch. A time delay circuit provides





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(For 60-cycle power) PRICE $875

SPECIFICATIONS

Optical System: Wollensak f/1.5 coated Raptar lens. Image reduction ratio 4.5.

Shutter: Permits "Time" and "Bulb." Provision for remote operation.

Writing-rate Capability: 35 in./μsec with Type P11 screen at 12,000 volts.

Film Speed: Variable in steps of: 0.8; 1.6; 2.5; 4.9; 7.4; 14.8; 22.2; 44.4; 66.6; 133.3; 200; 400; 600; 1200; 1800; and 3600 in/min with rolls up to 400 feet in length. Also 5400 and 10,800 in/min with film strips up to 10 feet in length. Accuracy of film speed within 2% at proper Line frequency.

Recording Material: Perforated or unperforated 35 mm film or recording paper in lengths up to 400 ft.

WRITE *for "Techniques of Photo-Recording," a 36-page handbook on cathode-ray photography.*

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For more information circle 57 on inquiry card.

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For more information circle **58** on inquiry card.

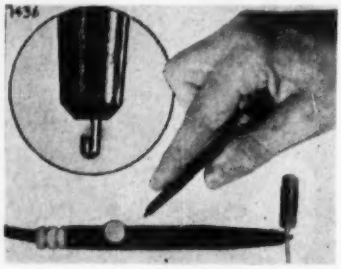
NEW INSTRUMENTS

variable separation between first and second output pulses.—*Berkeley Scientific Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.*

For more information circle **280** on inquiry card.

Test Probe

New "Mic-Con Test Probe" features a push-to-operate mechanism whereby only one hand is required



to make connection and both hands are free when connection has been made.—*Mic-Con, Inc., 521 Lehigh Ave., Union, N. J.*

For more information circle **281** on inquiry card.

UHF TV Test Equipment

New "Twin-300" line of balanced 300-ohm components and test equipment includes baluns, attenuators, detectors, and terminations suitable for use in UHF TV band; may be used with existing unbalanced 50- and 75-ohm equipment for complete measurements of balanced 300-ohm systems. New 300-ohm connector is suitable for use from d.c. to 2000 Mc.; a mating connector may be constructed without special tools or factory parts.—*Microlab, 301 S. Ridgewood Rd., South Orange, N. J.*

For more information circle **282** on inquiry card.

400-and-1000-cps. Oscillator

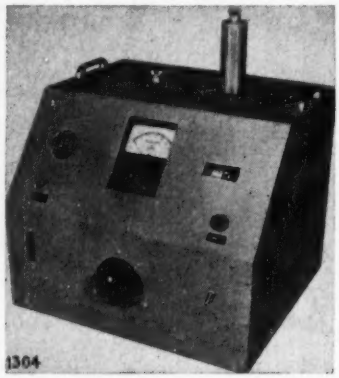
New "Model 1040 Power Oscillator" provides a frequency of either 400 or 1000 cps.; 3 watts of undistorted pow-

er (less than 1%) at various output impedance levels. A control on front panel allows for continuously variable output from 0 to 120 volts. Frequencies are said to be maintained with high stability even with line voltage variations.—*Industrial Test Equipment Co., 55 East 11th St., New York 3, N. Y.*

For more information circle **283** on inquiry card.

Insulation Tester

New "573A Hypot" provides a-c. output voltage continuously variable from 0 to 30,000 volts at 1 kva. capacity (1.5 kva. intermittent). Input is



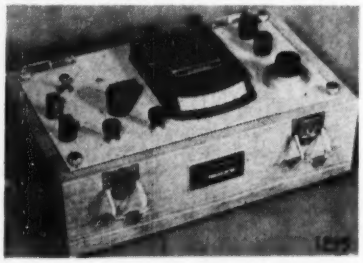
115 v.ac. Short-circuit protection is provided by a manually-reset primary circuit breaker with secondary trip. 4½-in. output voltmeter is connected directly across secondary so that accuracy of output voltage indication does not depend on transformer design.—*Associated Research, Inc., 3766 W. Belmont Ave., Chicago, Ill.*

For more information circle **284** on inquiry card.

ELECTRICAL INSTRUMENTS

Potentiometer

New "Model HF1" portable (9.4-lb.) potentiometer for laboratory and field use has a range of 0-100 mv. and an accuracy of 0.1 mv. plus 0.15 per-



cent. Galvanometer, though more sensitive than those usually found in portable instruments, does not require locking in transit, thereby avoiding damage due to forgetfulness. Auxiliary current source is a flashlight cell; switch turned off when cover is closed. Emf. standard is an Eppley unsaturated cell.—*Williamson Development Co., 317 Main St., West Concord, Mass.*

For more information circle **285** on inquiry card.

Eighty-eight-range Volt-and-ammeter

New "Universal 88 A.C. D.C. Polyranger," though of laboratory grade, has three features for field use: (1) requires no leveling; (2) "transit" switch position; (3) no need of temperature correction between 66 and 86 F. because this is said to be "the first electrical instrument to have auto-

Check these:

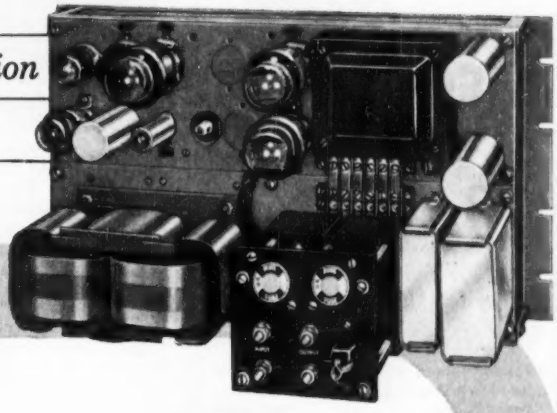
Stabilizing and Regulating Ability

Correction Speed

Waveform Distortion

Input Range

Output Range



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STABILINE TYPE IE

Instantaneous Electronic

AUTOMATIC VOLTAGE REGULATORS

Here's how the Stabiline type IE measures up:

Stabilizing and regulating ability — For all conditions maximum variation less than ±.25 of 1%. For input voltage changes, variation less than ±0.1 of 1%. Load current change or power factor change from lagging .5 to leading .9 will vary output voltage less than ±.15 of 1%.

Correction speed — Comparatively instantaneous — 3 to 10 cycles.

Waveform distortion — Never exceeds 3%. Is generally under 2%.

Input Range — For nominal 115 volts output, input range is 95 to 135 volts. For nominal 230 volts output, input range is 195 to 255 volts.

Output Range — Output voltage on 115 volt units can be adjusted from 110 to 120 volts; on 230 volt units from 220 to 240 volts.

Furthermore, the Stabiline type IE has a circuit simplicity and mechanical ruggedness that minimizes maintenance.

Check all these characteristics against all other automatic voltage regulators and you will find Stabiline type IE is *superior* in design, construction and performance.

Stabiline automatic voltage regulators type IE are available in ratings from .25 to 5.0 KVA. Special types will be application engineered to meet specific requirements.

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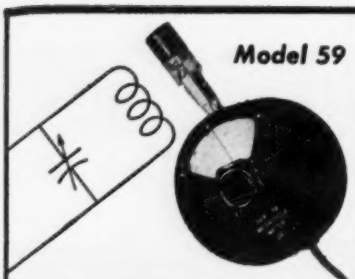

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2.2 mc. to 400 mc.

Frequency Accuracy ±2%

***The* MULTI-PURPOSE INSTRUMENT**

- **For determining the resonant frequency of tuned circuits, antennas, transmission lines, by-pass condensers, chokes, coils.**
- **For measuring capacitance, inductance, Q, mutual inductance.**
- **For preliminary tracking and alignment of receivers.**
- **As an auxiliary signal generator; modulated or unmodulated.**
- **For antenna tuning and transmitter neutralizing, power off.**
- **For locating parasitic circuits and spurious resonances.**
- **As a low sensitivity receiver for signal tracing.**

And Many Other Applications

FREQUENCY: 2.2 mc. to 400 mc.; seven plug-in coils.

MODULATION: CW or 120 cycles, or external.

POWER SUPPLY: 110-120 volts, 50-60 cycles; 20 watts.

DIMENSIONS: Power Unit: 5½" wide; 6⅛" high; 7½" deep. Oscillator Unit: 3¾" diameter, 2" deep.

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For more information circle **60** on inquiry card.

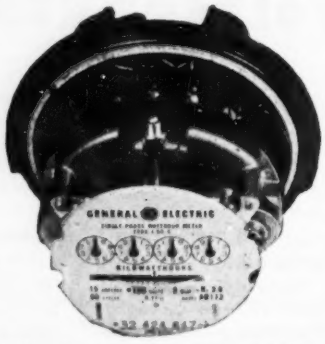
NEW INSTRUMENTS

matic temperature compensation on both d.c. and a.c." Instrument has 88 internal ranges, from microamperes and millivolts to amperes and 750 volts, overlapping so that all measurements can be read in upper part of 5.2-inch mirror scale where accuracy is better than maker's guarantee of 0.5 percent on d.c. and 0.75 percent on a.c.—*Sensitive Research Instrument Corp., 9-11 Elm Ave., Mount Vernon, N. Y.*

For more information circle **286** on inquiry card.

Universal Watthour Meter

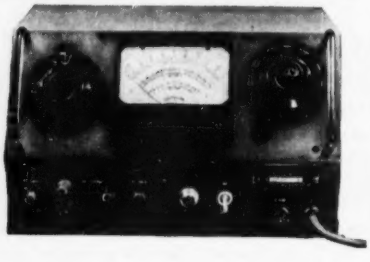
New "Type I-50 Universal" single-phase watthour meter incorporates all advanced design features of maker's standard "I-50" model, permits conversion to be made in the field from a 2-wire, 120-volt circuit to a 3-wire 240-volt circuit or vice versa: only tool a screwdriver and time is about one minute.—*Meter and Instrument Dep't, General Electric Co., 40 Federal St., West Lynn 3, Mass.*



For more information circle **287** on inquiry card.

FM Deviation Monitor

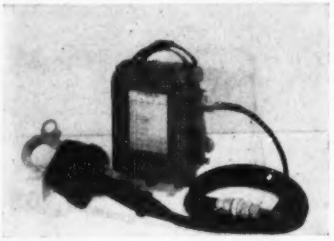
New "Model AR-1" is capable of measuring FM deviation from 50 cps. to 1 Mc. over a wide range of audio frequencies, with low inherent harmonic distortion at all modulating frequencies. Among features: Complete radio-frequency coverage in one band from 50 to 216 Mc.; facilities for distortionless FM signal demodulation for other instruments such as distortion meters; tuning extremely noncritical; printed circuit techniques.—*A.R.F. Products, 7627 W. Lake St., River Forest, Ill.*



For more information circle **288** on inquiry card.

Portable Recording Hook-on Volt-ammeter

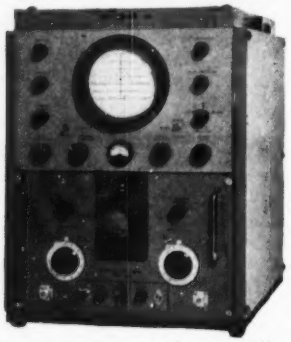
New "Type CF-7" instrument, for recording alternating current and voltage, combines features of a self-latching multirange hook-on current transformer and simplicity of inkless recorder; is suitable for in and outdoors. Current ranges 15/75/150/750 amps.; voltage 150/300/750; frequency 50 or 60 cps. Weight 18¾ lbs. including 10-ft. lead.—*Meter & Instruments Dep't, General Electric Co., 40 Federal St., West Lynn, Mass.*



For more information circle **289** on inquiry card.

Spectrum Analyzer

New "Model SA25 Microwave Spectrum Analyzer" with interchangeable r. f. heads is said to combine all the advantages of maker's previous microwave spectrum analyzers with new features engineered to provide optimal performance.—*Vectron, Inc., 386 Main St., Waltham 54, Mass.*



For more information circle **290** on inquiry card.

X-band Milliwattmeter

New "Power Meter" is a new type of instrument that measures rms power over frequency range of d.c. through X-band without use of frequency-limited bolometer mounts; is completely self-contained; employs a single power probe for all frequencies; can withstand 150 percent overload without burnout or other ill effects. Its power-sensitive element is

NOW...

THE 6000# HANCOCK STAINLESS STEEL

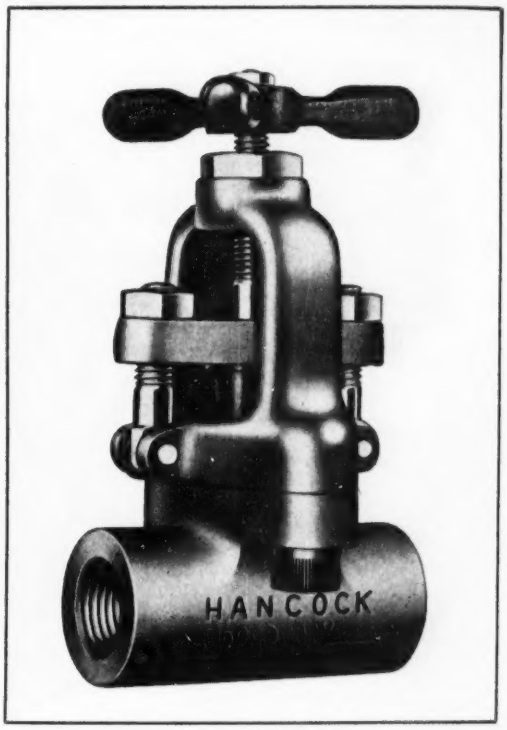
INSTRUMENT VALVE

A new HIGH PRESSURE valve for use on

INSTRUMENT PANELS	BY-PASS LINES
INSTRUMENT LINES	CORROSIVE LINES
GAUGE LINES	ORIFICE METERS

This heavy-duty Hancock Instrument Valve was specially engineered for these and similar services where high temperatures are of short duration and occur infrequently. It is small, easy to handle—weighs only 2¼ lbs. Space-saving compactness permits close alignment of piping with near structures. The packing gland can be readily pulled tight in close quarters. Disassembly is no problem in tight spots. Every practical use of stainless steel assures maximum protection against corrosion. You can be sure of long-life service and economical maintenance.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the 6000# Hancock Instrument Valve. He is as close as your telephone. Call him for complete specification and operational data. You can count on fast delivery to meet your requirements.



SPECIFICATION DATA

SERVICE RATING: 6000# O.W.G.—100° F.

TYPES: Globe and angle.

SIZES: ¼", ⅜" and ½".

CONNECTIONS: Screwed and socket weld ends.

BODY: Type 410 forged stainless steel with integral stuffing box.

YOKE: Forged carbon steel—bolted to body with two hollow head alloy steel cap screws removable with Allen-type wrench. **No bonnet joint**—no gasket to leak or blow.

STEM: 300 Brinell stainless steel with bronze stem thread bushing.

STEM-DISC: Needle point design.

SEAT: Type 410 stainless steel. Integral with the body.

PACKING GLAND: Forged steel. Packing gland bolts, nuts, pins and packing stop rings—stainless steel.

PACKING: Highest quality long fiber asbestos, graphited and corrosion inhibited.

HANDLE: Malleable iron. Three-prong type for easy operation. Handle nut—steel.

MARKER PLATE: Stainless steel.

1877 HANCOCK U.S.A.

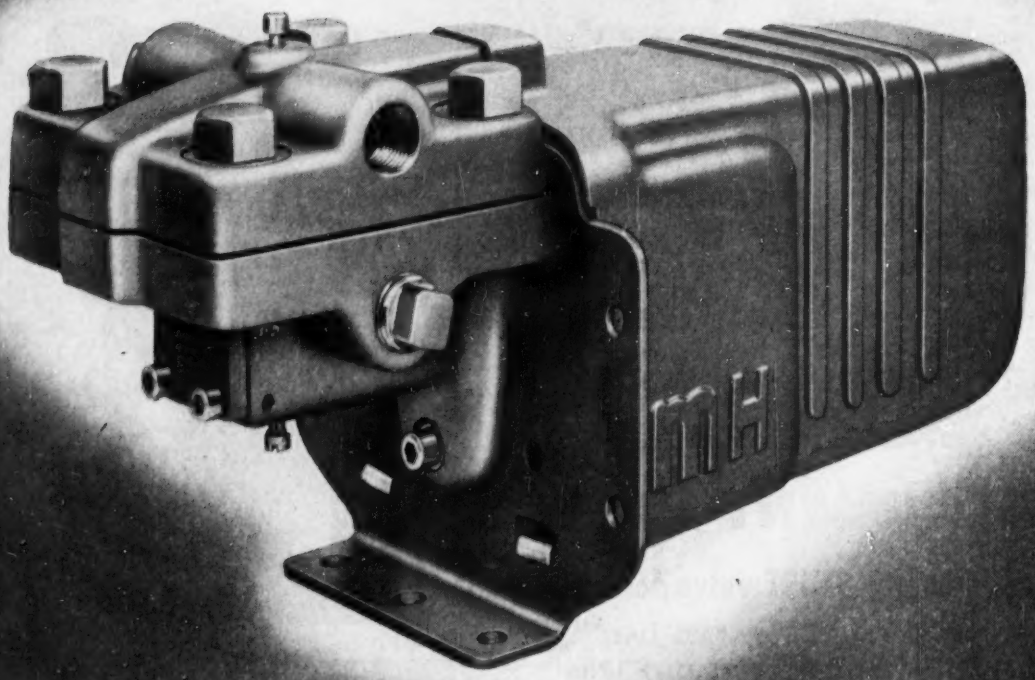
When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more information circle **61** on inquiry card.



compare these features!

simplicity:
uses no mercury; a rugged pneumatic balance transmitter, it has few moving parts . . . needs practically no maintenance.

wide range:
readily adjustable in the field for ranges from 0–20 to 0–200 inches of water.

simple calibration:
easily calibrated with weights . . . no curves or tables needed; 1 lb. equals 10″ of water.

withstands overloads:
takes many times rated pressure without loss of accuracy or damage to working parts.

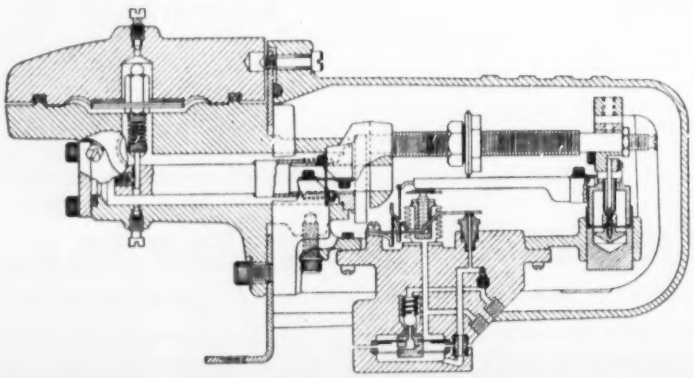
for use with miniature instruments:
converts pressure differential at the metering orifice into a proportional air pressure for transmission to remote indicators, recorders or controllers. The ideal companion for *Tel-O-Set* miniature instruments.

temperature range:
handles fluids at temperatures as high as 350° F.

versatility:
available with or without non-bleed pilot booster relay.

sensitivity:
responds rapidly to quick changes in flow.

easy installation:
lightweight, compact unit is readily mounted anywhere.



For flow measurements— the **HONEYWELL DIFFERENTIAL CONVERTER** *is better than ever*

NEW CONSTRUCTION features now make the Honeywell Differential Converter, more than ever, the standard of performance for remote measurements of flow and differential pressure.

It's more accurate than ever . . . has improved linearity of response. It's more stable, with a larger dashpot and heavier oil to smooth out spurious line fluctuations. And it's even more rugged . . . can take overloads of many times normal pressure without damage to the diaphragm or impairment of precision.

More than ten thousand Honeywell Differential Converters have been installed on an ever broadening variety of applications . . . on pipelines, in conjunction with graphic instrumentation, and in scores of other uses which need accurate, flexible remote transmission of measurements.

You can see what's behind this industry-wide acceptance, by checking the Differential Converter's outstanding features described on the opposite page. You can find out even more by testing it yourself, under any operating conditions your plant may present. And for a personal discussion of your individual process requirements, call your local Honeywell sales engineer . . . he's as near as your phone.

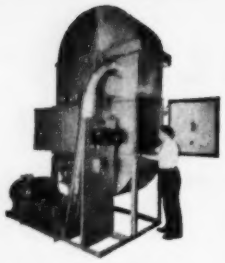
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin 2290, "Honeywell Differential Converters."**

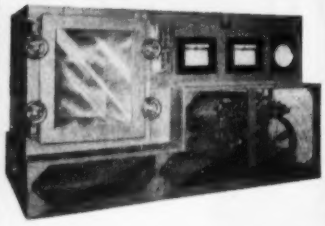
MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

For more information circle **62** on inquiry card.

AR★
ENVIRONMENTAL
TEST EQUIPMENT



SAND & DUST test chambers with completely automatic dust density control.



ALTITUDE chambers for testing from sea level to 100,000 ft. or higher with temperatures from —100° F to +200° F.

HUMIDITY chamber simulates relative humidity from 20% to 100% between +35° F and +200° F.

American Research Test Equipment can be designed and built in a variety of sizes and ranges to meet specific requirements.

Write for catalog.

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383 BROOK ST. BRISTOL, CONN.

For more information circle **63** on inquiry card.

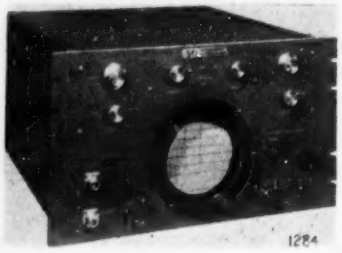
NEW INSTRUMENTS

used for entire frequency range, obviating need for replaceable components. Two power scales: 0-20 and 0-100 milliwatts. Power range may be extended through use of directional couplers, fixed pads or variable attenuators.—*Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

For more information circle **291** on inquiry card.

Cathode-ray Indicator

New "Model 600 Cathode Ray Indicator" utilizes high-writing-speed capabilities of type 5XP cathode-ray tube in applications too advanced or



special for standard oscilloscopes; is designed to be used with maker's "Model 610 High Speed Sweep Generator" so that total writing speeds in excess of 500 cm./usec. may be obtained. Operation at high potentials is completely safe.—*Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Ave., Cambridge 39, Mass.*

For more information circle **292** on inquiry card.

Signal Generator

New "Model MB-1" battery-operated oscillator has "Microvolter" calibrated output attenuator and level meter. Combination is especially use-

ful as a "transducer simulator" for field use. Both d-c. and a-c. signals are available, from 0.1 volt to 1 microvolt, at output impedances of 10 to 500 ohms. Frequency range of oscillator is 2 to 20,000 cps., calibrated within 2 percent; distortion is less than 0.5 percent in audio range. Either oscillator or attenuator may be used independently without disassembly. Both are available separately if desired.—*Southwestern Industrial Electronics Co., 2831 Post Oak Road, Houston 19, Texas.*

For more information circle **293** on inquiry card.

Peak-value Indicator

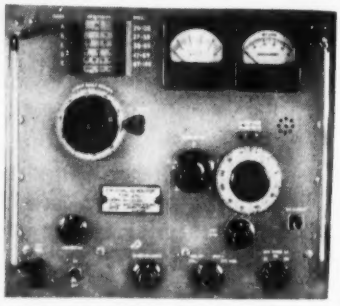
New "Model PTM-7 Peak Meter" is a ballistic voltmeter which holds reading of peak value of a single voltage waveform until manually reset. Fea-

ture is a memory circuit, said to be unique, which makes possible accurate measurement of pulses faster than 5 microseconds. Indication will not decay more than 1 percent in half an hour. Applications include pressure, acceleration, strain, etc.—*Control Devices, Inc., 9918 Charlevoix Ave., Detroit 14, Mich.*

For more information circle **294** on inquiry card.

FM Signal Generator

New "Type ASG-1" signal generator produces f-m. signal from 20 to 100 Mc. in five bands. Frequency deviation is from 0 to 150 kc. Frequency



stability (short term) is better than 0.01 percent. Accuracy of calibration marks is 0.005 per cent.—*A.R.F. Products, Inc., 7627 Lake St., River Forest, Ill.*

For more information circle **295** on inquiry card.

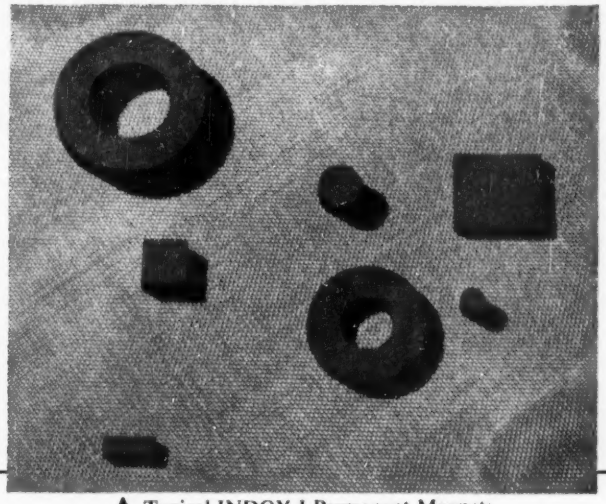
ELECTRICAL-INSTRUMENT ACCESSORIES

Laboratory-type Delay Line

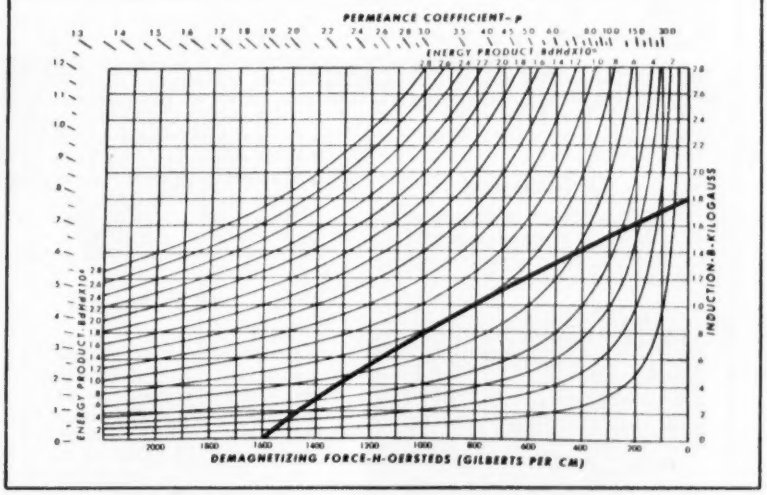
New "Type A" laboratory type delay line is variable in additive increments of 0.2 usec. each; is of lumped constant type with a total maximum delay of 1.0 usec. (measured at half amptitude) with a risetime of 0.05 usec. (measured at 10 percent and 90 percent amptitude). Characteristic impedance is 50, 75 or 100 ohms, and maximum peak voltage is 500. It is constructed so that each individual switch controls a step of 20 coils and 20 matched capacitors. It is also produced in distributed-parameter type

Presenting INDOX I... A

NEW CERAMIC PERMANENT MAGNET



▲ Typical INDOX I Permanent Magnets



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For more information circle **64** on inquiry card.

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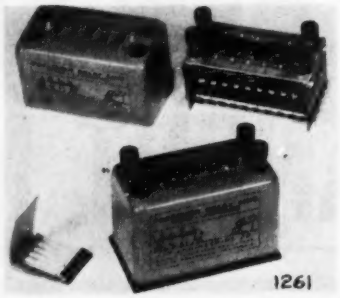
NEW INSTRUMENTS



for high characteristic impedance. ★Also available "Type B": same chassis, with steps of 0.05, 0.01, 0.15, 0.3, and 0.5 usec., to total 1.0 usec., thereby making it possible to switch in any delay from 0 to 1.0 usec. in increments of 0.05.—*May Engineering Co., 6055 Lankershim Blvd., North Hollywood, Calif.*

For more information circle **296** on inquiry card.

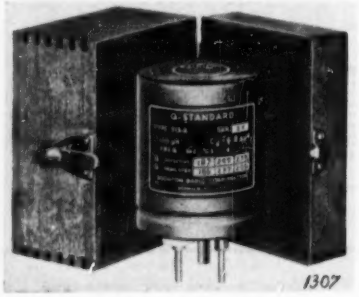
Voltmeter Inverter

New "Model 214 Voltmeter Inverter" extends usefulness of conventional a-c. VTVMs to d-c. measurements such as null detection, photometry, thermometry, etc. Range, 100 microvolts to 100 volts; d-c. input resistance, approx. 0.5 megohm; a-c. output impedance, approx. 30,000 ohms max.; a-c. output frequency, square wave of line frequency.—*Brunswick Instruments, P. O. Box 813, New Brunswick, N. J.*

For more information circle **297** on inquiry card.

Q Standard

New "Type 513-A Q-Standard" provides known Q and reactance for precise measurements and for checking Q-meter performance. Consists of a



winding of litz wire on a low-loss steatite coil-form mounted in a hermetically-sealed copper-shield can filled with dry helium. Nominal inductance 250 uh. Distributed capacitance approx. 9.0 uuf. Each inductor is individually calibrated; accuracy 3 percent in terms of effective Q. Humidity has negligible effect on electrical characteristics.—*Boonton Radio Corp., Boonton, N. J.*

For more information circle **298** on inquiry card.

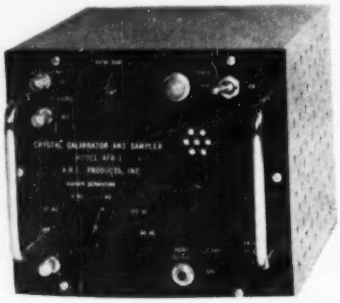
Marker Generator

New "WR-89A" crystal-calibrated marker generator, featuring continuously tunable operation for alignment and trouble-shooting of a wide range of electronic communications equipment as well as TV sets. It combines functions of a marker generator, a vertical or horizontal bar-pattern generator, a rebroadcast transmitter, and a heterodyne frequency meter. It provides an rf-output signal on fundamental frequencies from 19 to 260 Mc. and can be used with TV receivers, etc. Built-in crystal-controlled oscillator provides a 4.5-Mc. output signal.—*Tube Dep't, RCA Victor Div., Radio Corporation of America, Camden, N. J.*

For more information circle **299** on inquiry card.

Marker-generator

New "Model AFR-1" crystal calibrator type marker-generator provides audio- or video-frequency marks at even intervals without interruption

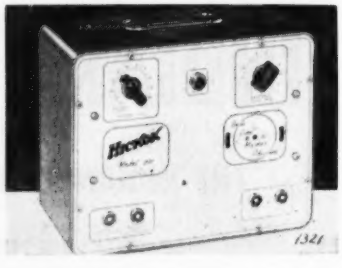


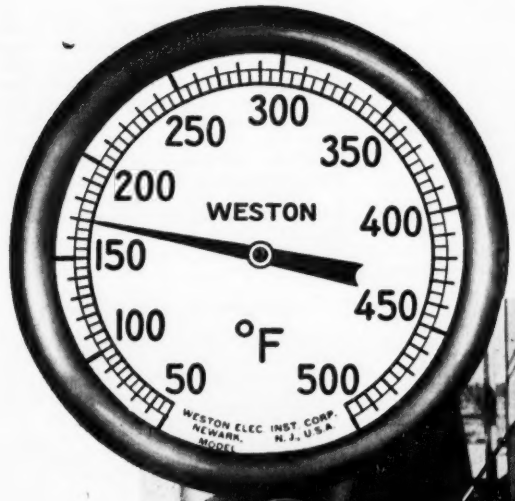
of tested circuit. Features: Low VSWR sampler for use in 50-ohm structure; wide choice of mark separation frequencies (0.05, 0.2, 1.0, 5.0, and 20 Mc.); photoetched circuitry; mark-separation frequency generated by crystal-controlled oscillators. Applications include calibration and alignment for signal generators, receivers, transmitters, etc.—*A.R.F. Products, Inc., 7627 W. Lake St., River Forest, Ill.*

For more information circle **300** on inquiry card.

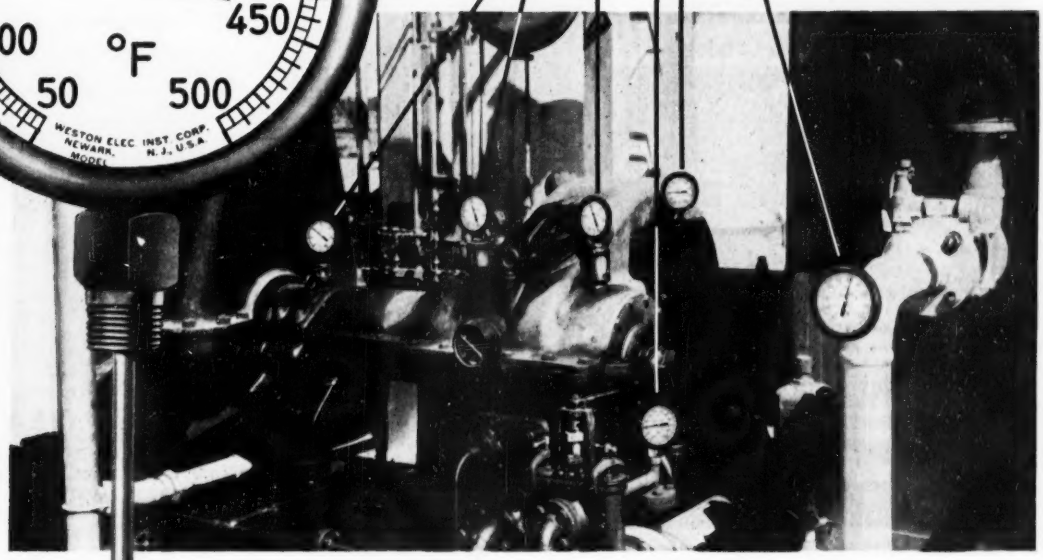
TV Marker

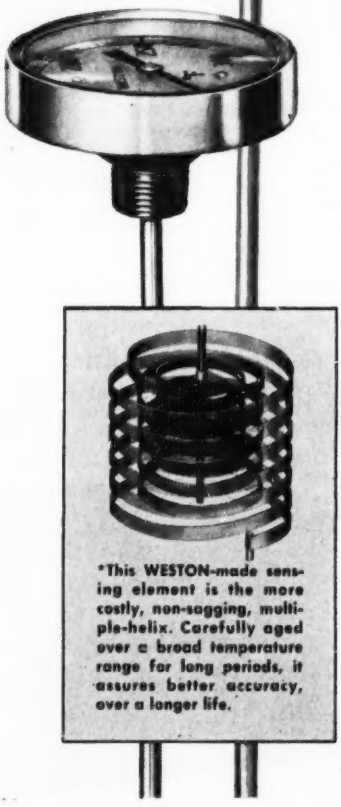
New "Model 691," when used with any sweep generator equipment that has an output of 50,000 microvolts or more, provides a marker visible at all times (including trap points) and will not change in amplitude or distort response curve. Output of sweep generator and marker generator are heterodyned and applied to an oscilloscope so that marker signal does not pass through receiver, therefore cannot cause overloading. Characteristics: marker voltage up to 3 volts; variable





AT EVERY CHECKPOINT





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(with Multiple Helix)*

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Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON 5537 *Thermometers*

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For more information circle **66** on inquiry card.

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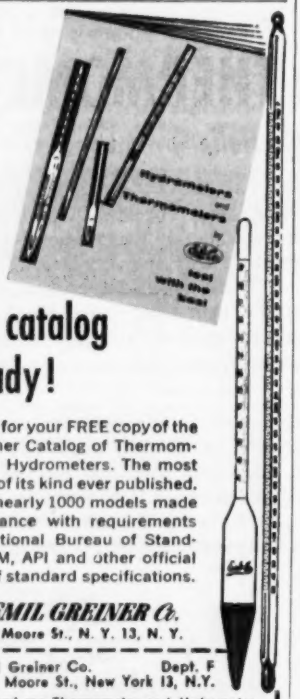

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For more information circle 68 on inquiry card.

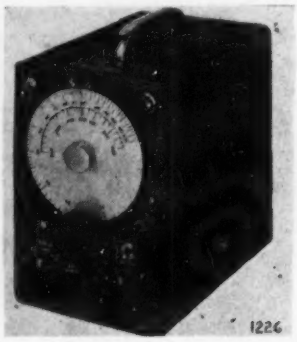
NEW INSTRUMENTS

attenuation of markers from 0 to 60 db.—*The Hickok Electrical Instrument Co.*, 10528 *Dupont Ave., Cleveland, Ohio.*

For more information circle **301** on inquiry card.

Audio Oscillator

New "Model 411" oscillator is for making measurements requiring a sine-wave signal over range 20 cps. to 1 Mc. An *R-C* tuned type oscillator

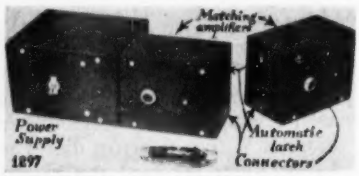


and a cathode follower in output system are employed to provide uniform response. Low level measurements are facilitated by a panel switch which reduces output voltage, distortion and hum output.—*Dep't I, Clough-Brengle Co.*, 6014 *Broadway, Chicago* 40, *Ill.*

For more information circle **302** on inquiry card.

Matching Amplifier System

New "Model 100 Matching Amplifier System," for coupling high-impedance generators to conventional laboratory recorders, CRO's, etc., com-



prises a supply of 6.3-v. 3-amp. and of well-filtered B-plus voltage; and up to ten amplifiers designed for instrument work; all units of plug-in construction. Power supply is 4x5x6 in.; amplifiers 3x4x5 in.—*VibraShock Corp.* 5232 *River Rd., Washington* 16, *D. C.*

For more information circle **303** on inquiry card.

Magnetic Amplifier

New "Model MM-421" magnetic d-c. amplifier is intended for amplifying low-level signals from thermometers, chemical pickups, photocells, etc.; produces a 0-to-5-v.dc. output for telemetering purposes; requires 6.3 volts, 0.001 amp. 400 cps.; has a d-c. voltage gain in excess of 1500. Input resistance is 125 ohms. Output voltage ripple is less than 25 mv. Zero drift is less than 0.1 percent of full-scale output from −75 F. to 200 F. Linearity is better than 2 percent. Smallest detectable signal power is 10^{-12} watt. Unit is hermetically sealed in thermosetting plastic.—*Magnetic Research Corp.*, 318 *Kansas St., El Segundo, Calif.*

For more information circle **304** on inquiry card.

Magnetic Amplifiers

New "Models M-21 and M-22" low-level high-gain magnetic amplifiers are of exceptionally small size 2x2x2½-in. case). "Model M-21," for current measurement (photocells, etc.), has an input-output linear characteristic for signals of 0 to 25 microamp. d.c. Output: 0 to 5 milliamp. d.c. into a load of 100 ohms. Input resistance: 25 to 100 ohms. "Model M-22," for thermocouples, etc., has an input-output linear characteristic for signals of 0 to 10 millivolts. Output: 0 to 5 milliamperes d.c. into a load of 3000 ohms. Minimum input resistance: 3 ohms. Power gain of both models is about 50,000 at 60 cps. and 100,000 at 400 cps. Zero drift of both is about 10^{-12} watt.—*Magnetic Controls, Inc.*, 119 *W. 63rd St., New York* 23, *N. Y.*

For more information circle **305** on inquiry card.

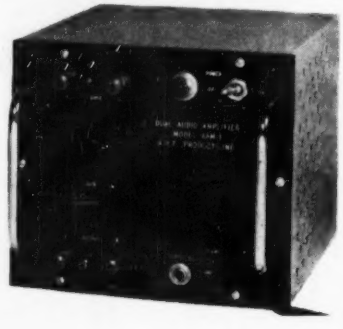
Booster Amplifier

New "Model 5116" miniature amplifier is a plug-in two-stage low-noise preamplifier or booster amplifier, said to be "the smallest high-performance amplifier of its type that exceeds FCC requirements." Gain is 40 db. Frequency response is 0.5 db 30 to 15,000 cps.; dimensions are 9x3.37x3.12 in.; output power is 0.063 watt.—*Langevin Mfg. Corp.*, 37 *W. 65th St., New York* 23, *N. Y.*

For more information circle **306** on inquiry card.

200-kc. Amplifier

New "Type AAM-1" dual amplifier has two channels with gain of 40 db each, permitting total gain of 80 db. Each channel is *R-C* type with re-

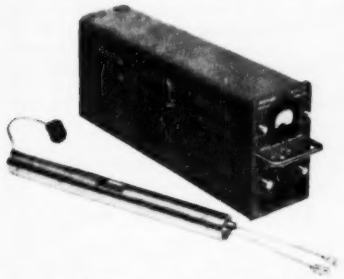


sponse within 0.2 db from 10 cps. to 50,000 cps.; within 2.5 db to 200,000 cps. Maximum output is 50 v. rms. Signal-to-noise ratio at max. output is 68 db.—*A.R.F. Products, 7627 W. Lake St., River Forest, Ill.*

For more information circle **307** on inquiry card.

Broad-band RF Amplifier

New "Model 24 Broad Band Amplifier" utilizes a traveling-wave tube to provide high gain over 2000-4000-Mc. Typically, small-signal gain av-



erages 35 db and saturation output power 30 mw. Maximum noise figure is 20 db or less. The unit is completely self-contained, including regulated power supplies and traveling-wave tube focusing structure; is directly usable as either a laboratory tool or a system component.—*Westlabs Inc., P.O. Box 1111, Palo Alto, Calif.*

For more information circle **308** on inquiry card.

POWER SUPPLIES

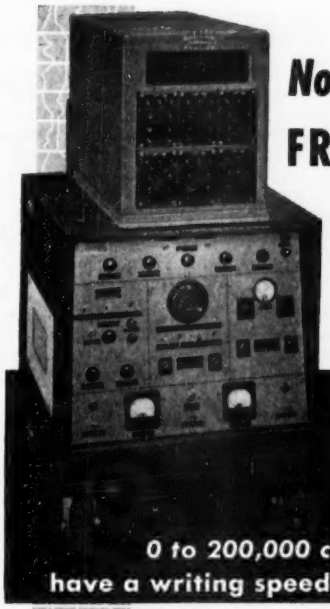
Miniature D-c. Power Packs

New "Transpac" sealed miniaturized a-c.-operated d-c. power packs, designed to be wired directly into circuits for powering transistors, guided-missile elements, computers, etc., save space, weight and wiring; are available in constant-current or constant-voltage types with a variety of output currents or voltages, in single-output or multi-output designs for feeding multiple stages, and in 60- or 400-cps. models. Other features include input line voltage regulation, load regulation, and low ripple content. Design features include line isolation by means of an input transformer, bridge rectification using semi-conductor diodes, use of selenium regulators, and high-efficiency filtering. "Transpacs" meet commercial or military specifications.—*Electronic Research Associates, Inc., 715 Main St., North Caldwell, N. J.*

For more information circle **309** on inquiry card.

D-c. Power Supply

New "Model 302" power supply is said to "provide more power output volumetrically than any other commercially available small power supply" (dimensions 8x5x5½ in.). Two outputs are available: (1) from 150 to 350 volts at 0 to 80 milliamps, with



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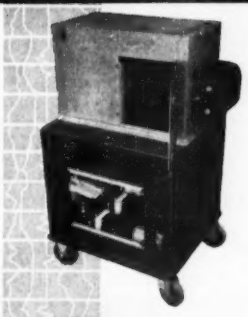
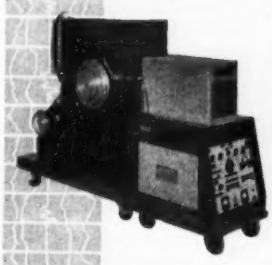


Fast transients and high-frequency phenomena now can be accurately recorded.

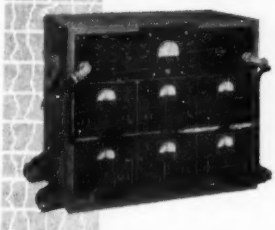
Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. The magazine shown on the oscillograph at the left accommodates 100-foot rolls of record paper.



Drum-type magazines, both small and large, are valuable for short high-speed records. The large drum-type magazine at the left has a drum 3 feet in diameter and 6-inches wide. It can be driven at 3000 RPM for a *chart speed of 6000 inches per second* when high resolution is needed. It can be used to take one 10-foot record or a larger number of shorter records.

The ASC-10 6-element direct-coupled amplifier will drive the SC-16 oscillograph from potentials of millivolt level.

Useful for strain recording to 100 Kilocycles.



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For more information circle **69** on inquiry card.

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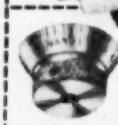

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For more information circle **71** on inquiry card.

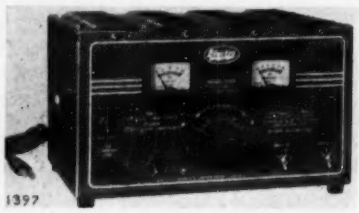
NEW INSTRUMENTS

regulation better than 0.05 percent; (2) from 0 to 150 volts at 0 to 5 milliamps, with regulation better than 1.0 percent against line variations only. Ripple is less than 3 millivolts.—*Allied Engineering Div., Allied International Inc., Connecticut & Richards Aves., South Norwalk, Conn.*

For more information circle **310** on inquiry card.

D-c. Power Supply

New "Model D-612" is a completely assembled d-c. power supply said to be priced to compete with kit-type supplies and to be ideal for servicing

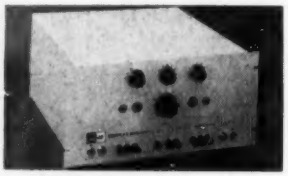


all commercial 6- or 12-volt auto radios, battery charging, electroplating, etc. Continuously-variable output 0-8 v. and 0-16 v.dc.; maximum continuous current rating 10 amps. up to 12 v. (intermittent 20 amps.); conduction cooling and selenium rectifiers.—*Electro Products Labs.*, 4501 *Ravenswood Ave., Chicago* 40, *Ill.*

For more information circle **311** on inquiry card.

D-c. Power Supplies

New "Model 50C-50" incorporates absolute power supply system: output voltage constantly compared and stabilized against internal standard cell.



This system is said to afford the ultimate in long time stability, combined with 0.01 percent regulation for full load current and 10 percent line changes. Output hum and noise under 0.5 millivolt and output impedance under 0.1 ohm. Other models available covering wide range of voltage and current.—*Kalbfell Labs., Inc.*, 1090 *Morena Blvd., San Diego* 10, *Calif.*

For more information circle **312** on inquiry card.

Airborne Power Supplies

New non-electronic "Airborne Power Supplies" with ratings of 25 to 500 amp. at 28 v.dc. consist entirely of non-wearing or static electrical components, principally selenium rectifier cells and magnetic amplifiers. Close regulation of output voltage and fast response are achieved by use of a unique voltage-sensing network. Units meet JAN specs and Air Force Exhibit WCEE2-2A, Nov. 1951. Paralleling of two or more power supplies is accomplished by one simple, foolproof inter-connection. 1000 hours' life guaranteed, 2000 hours expectable. Units are absolutely insensitive to temperatures from −65 C. to 72 C., withstand all conditions of moisture, sand, dust, and salt spray.—*Inet, Inc.*, 8655 *South Main St., Los Angeles* 3, *Calif.*

For more information circle **313** on inquiry card.

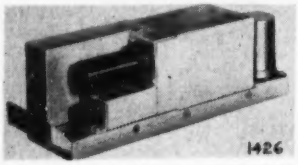
Airborne Power Supply

New type of airborne hermetically-sealed power supply, rated at 6,000 volts ±5 percent with an output current of 100 microamperes, is also provided with a 600 v.dc. output voltage tap; is designed for input of 100-120 v.ac., 380-420 cps., single phase. Ripple voltage is below 120 volts peak to peak. Unit operates over a temperature range of −55 C. to 85 C.—*Perkin Engineering Corp.*, 345 *Kansas St., El Segundo, Calif.*

For more information circle **314** on inquiry card.

Plug-in Power Supply

New "Type 5208 Plug-in Power Supply," for use with maker's "5,000 Series" miniature plug-in amplifiers,



is said to be miniaturized "to almost unbelievably compact size." D-c. output: 300 volts, 90 ma, continuous; a-c. output: 6.3 volts, 2.1 amps., continuous.—*Langevin Mfg. Corp.*, 37 *W. 65th St., New York* 23, *N. Y.*

For more information circle **315** on inquiry card.

Power Supply Modification

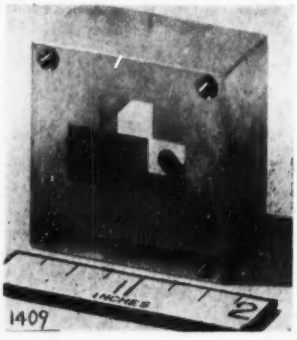
New 12-volt d-c. modification kit for maker's "Models B and BJ" 6-volt d-c. power supply units comes complete with all necessary parts, instructions and diagrams. Immediate delivery.—*Electro Products Labs.*, 4501 *Ravenswood Ave., Chicago* 40, *Ill.*

For more information circle **316** on inquiry card.

ELECTRICAL AND ELECTRONIC COMPONENTS

Microwave Components

New broad band impedance-matched 90-deg. short twist is for X band in RG-52/U waveguide size. Tapped holes in twist block faces will



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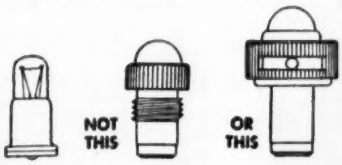

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For more information circle **72** on **inquiry card.**

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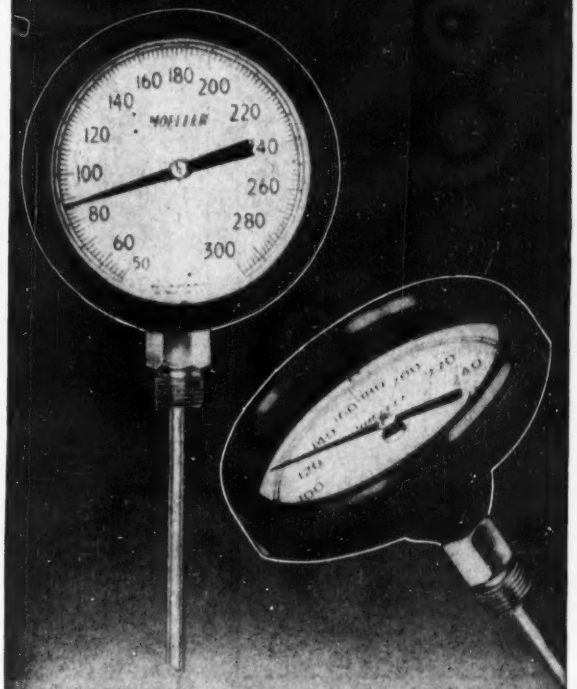

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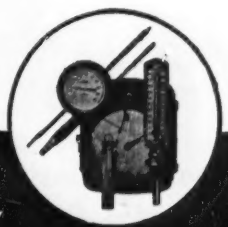

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For more information circle **75** on inquiry card.

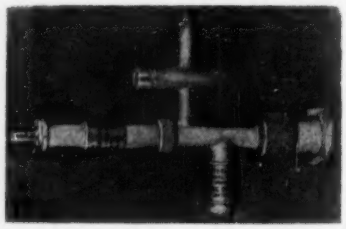
NEW INSTRUMENTS

determine angular orientation of mating UG-40A/U choke flange terminated waveguides.—*General Precision Laboratory, 63 Bedford Rd., Pleasantville, N. Y.*

For more information circle **317** on inquiry card.

Coaxial Crystal Mixers

New "Model CM-107" series of eight fixed tuned coaxial crystal mixers cover frequency range from 225 to 5600 Mc.; input VSWR is better



than 2 to 1, without adjustments, for all frequencies within nominal frequency range. Local oscillator power requirement is 10 milliwatts; local oscillator rejection at i.f. output is better than 30 db. Connectors available: "Type N," or UG-46/U.—*Empire Devices Products Corp., 38-15 Bell Blvd., Bayside 61, N. Y.*

For more information circle **318** on inquiry card.

Beam Switching Tubes

New "Types MO-10, MO-10R, DC-1 and DC-1R" beam switching tubes are essentially high-speed electronic switches in the form of ten pentode-

like tubes in one small envelope. They permit forming, switching and modulating an electron beam in ten discrete positions, either consecutively or at random. Fractional-microsecond switching from output to output is obtained from a single impulse or from high-speed pulses up into megacycle range. These are high-vacuum tubes using standard operating voltages and minimum power, hence useful in counting, computation, telemetering and automatic control. Samples available with a test chassis which clamps tube-and-magnet assembly in a socket and conveniently mounts all spade and target resistors except where resistors are internally mounted in tube.—*Electronic Instrument Div., Burroughs Corp., 511 North Broad St., Philadelphia 23, Pa.*

For more information circle **319** on inquiry card.

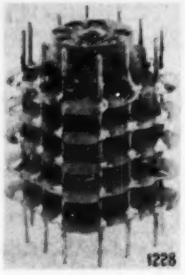
Frequency-control Crystal

New hermetically-sealed crystal in maker's "G-9" series is available with flexure mode crystals from 4 to 80 kc. for precise frequency control at temperatures in −40 to +70 C. range. Crystals have a high capacitance ratio C_0/C resulting in a high degree of isolation from associated circuitry. New unit provides a practical means of close frequency control in a range not covered by any other single type of crystal.—*James Knights Co., Sandwich, Ill.*

For more information circle **320** on inquiry card.

Modular Design Kit

New "PT-1000 Project Tinkertoy Kit" includes not only all module parts but all hand tools, materials, chemicals, and standard accessories requisite for design and construction of modules and subassemblies of Navy-sponsored National Bureau of Standards' "Project Tinkertoy" (modular design of electronic equipment and automatic production of such designs). Kit's fifty different items include assortments of 1200 precured resistors and of 1200 ceramic capacitor bodies, etc.—*Communication Measurements Lab., Inc., 350 Leland Ave., Plainfield, N. J.*



For more information circle **321** on inquiry card.

Miniature Twin Tetrode

New "Type 6360" twin tetrode has over-all length of 3 1/16 in. and ⅞ in. diam. For driving higher power and higher frequency push-pull stages, tube is designed for use as Class-C amplifier and oscillator, frequency multiplier, and modulator for frequencies to 200 Mc.; delivers 16 watts at 200 Mc.—*Amperex Corp., 230 Duffy Ave., Hicksville, L.I., N. Y.*

For more information circle **322** on inquiry card.

Diode Pentode

New "Type 6AM8" diode-pentode vacuum tube is similar to a 6CB6 plus one-half a 6AL5 in 9-pin construction. Pentode section has a transconductance of 5800 in typical operation. Addition of diode allows tube to be a combined i-f. amplifier and video detector, aiding reduction of tubes in TV receivers.—*Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.*

For more information circle **323** on inquiry card.

Vacuum Rectifier

New "6AU4-GT" glass-octal-type half-wave vacuum rectifier, for use as a damper diode in TV receivers, is rated to withstand a maximum peak inverse plate voltage of 4500 volts, can supply a maximum peak plate current of 1050 ma. and a maximum dc plate current of 175 ma.—*Tube Dep't, Radio Corporation of America, Harrison, N. J.*

For more information circle **324** on inquiry card.

UHF Triodes

New "6263 and 6264" are small "pencil-type" triodes with external plate radiators, for use in low-power mobile transmitters, and in aircraft transmitters at altitudes up to 60,000 feet without pressurized chambers. Maximum plate-dissipation rating 13 watts (ICAS); can operate with full ratings up to 500 Mc. and with reduced ratings up to 1700 Mc. "6263" has a mu of 27; "6264" of 40.—*Tube Dep't, Radio Corporation of America, Harrison, N. J.*

For more information circle **325** on inquiry card.

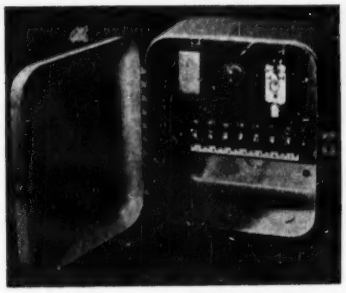
Temperature-limited Safety Diodes

New "2AS-15" and "2SM-15" tubes incorporate an automatic safety device whereby an external high-impedence circuit is closed in event of filament failure; have similar electrical specifications: E_G 1.8 ac/dc., I_G 310-335 ma.; E_P 500, I_P 0.41-0.55 ma. "2AS-15" uses a T9F1 bulb and 8537 8-pin intermediate octal base; "2AS-15" uses a T5½ bulb and T5½ 7-pin miniature button base. Both have temperature-limited emission characteristic: small changes in filament voltage result in relatively large changes in anode current. Owing to use of a pure tungsten cathode, specified ratings are maintained throughout normal life of tube.—*Thermosen, Inc.*, 361 *W. Main St., Stamford, Conn.*

For more information circle **326** on inquiry card.

Electronic Relay

New "Electronic Pilot Relay" operates without warm-up on a current flow of 2 microamperes, permits delicate mechanisms with light contact

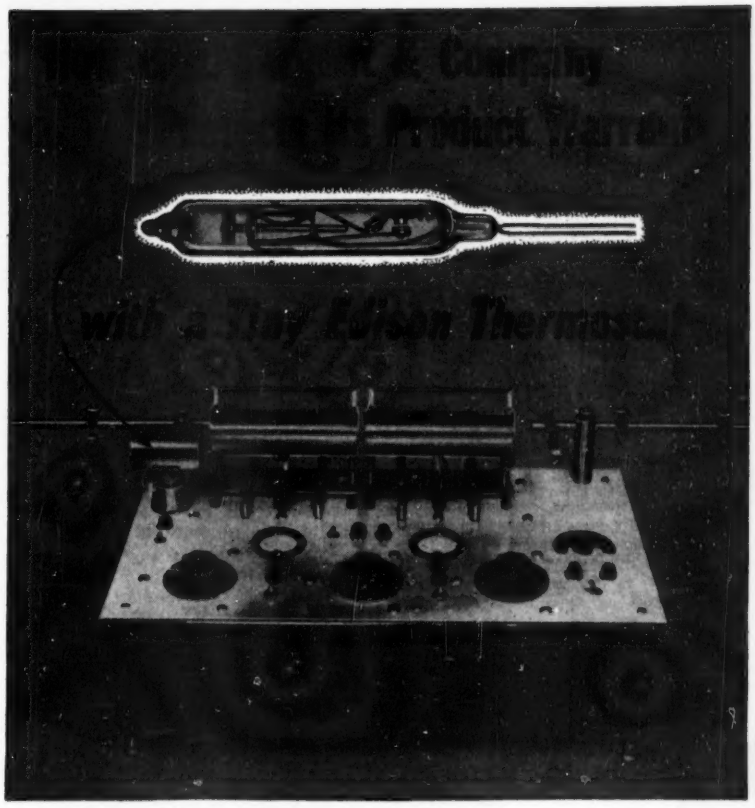


pressures to control large electrical currents. Its cold-cathode triode ("Type TT-1") is designed for use under extremely rugged conditions: has no heater filament, has unlimited life. Relay will operate over any input resistance from a dead short to 10 megohms, with leads of unlimited length. Current amplification up to 2½ million. Relay utilizes 115-v.ac. line source, consumes 2 watts when in operation.—*Haledy Electronics Co., 57 William St., New York 5, N. Y.*

For more information circle **327** on inquiry card.

Photoelectric Relay

New "T Series" photoelectric relays have built-in electronic time delays to extend plate relay ON or OFF time to practically any desired period



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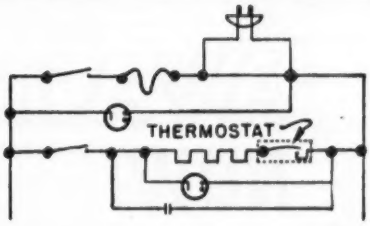
SPEED, accuracy and exact reproducibility are a few of the qualities designed into E. H. Sargent & Company's line of micro combustion furnaces. Advanced engineering methods and reliable components are necessary for dependable performance.

A VITAL COMPONENT in these instruments for analyzing a compound for its carbon and hydrogen content is an EDISON type S1-1A thermostat. It controls the temperature of the lead dioxide absorbent in the combustion train to insure the complete removal of all nitrogen oxides before the gases are passed into the final absorbing tubes for weighing. The mortar containing the absorbent is held to 177° C ± 2° C. Below temperature the absorbent does not remove the oxides of nitrogen efficiently and above temperature the absorbent starts to decompose and may release the oxides already absorbed. Any substantial temperature variation may cause an error in the final determination.

THE SARGENT high speed radiant heat furnace can operate for extended periods at



900° C and is designed for rapid cooling. The thermostatic control in the mortar must be responsive yet accurate and able to stand up for years without drift or change in setting.

EDISON THERMOSTATS feature stability measured in years, control within ± 0.1° F and capacity to 115 volts, 8 amperes d.c. or 1000 watts. EDISON temperature control engineers will be glad to work with you on the solution of your ambient protection problems. Just call or write to:

Thomas A Edison
INCORPORATED
Instrument Division
Dept. 24, West Orange, New Jersey

EDISON INSTRUMENTS

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For more information circle **76** on inquiry card.

LABORATORY APPROVED
Under MILITARY SPECIFICATION MIL-M-10304

- Will withstand Hi-Impact Shock Tests, extensive vibration and tumbling requirements, extreme thermal shock, humidity and temperature tests.
- Glass to metal type seal with molded vulcanized rubber terminal connections capable of carrying 30 amps for self-contained units.
- Magnetically shielded.
- Black satin anodized aluminum bezel.
- D'Arsonval permanent magnet type movement—for all D. C. Ranges.
- Available in 2½" and 3½" round case types.
- Guaranteed one year against defective workmanship and materials.

BURLINGTON INSTRUMENTS ALSO AVAILABLE IN HERMETICALLY SEALED OR BAKELITE CASES IN 1½" THROUGH 4½" SIZES.

BURLINGTON INSTRUMENT COMPANY
131 Third Street, Burlington, Iowa

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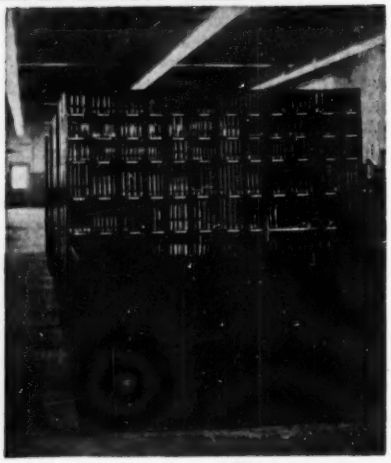

—in a wide variety of designs, sizes and materials.

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494 Westfield Ave., East Roselle Park, New Jersey
THERMOWELLS and other Specialties for the Process Industries

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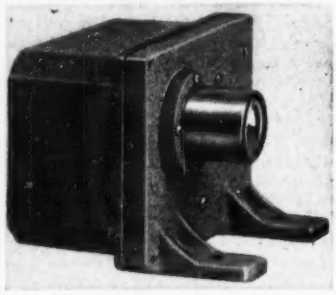
NEW INSTRUMENTS



after interruption or restoration of light beam. Both fixed and adjustable time delays are available.—*Autotron Co., P. O. Box 722-CC, Danville, Ill.*

For more information circle **328** on inquiry card.

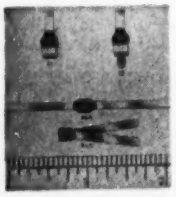
Oil-filled Capacitors

New small-case-size inverted single-stud-mounting tubular oil-filled capacitors are now available in ratings of 8 ufd. and dual 4 ufd. at 600 v.dc.; 4 ufd. and dual 2 ufd. at 1000 v.dc.; and 2 ufd. at 1500 v.dc. Designed for use where chassis space and ease of mounting are prime factors. Temperature range for "Indco Oil" type is from –40 to 70 C.; "Pyroteen" –70 to 90 C.—*Dept. 1-23, Industrial Condenser Corp., 3243 N. California Ave., Chicago, Ill.*

For more information circle **329** on inquiry card.

Subminiature Capacitors

New UHF subminiature ceramic capacitors, developed to minimize inherent series inductance, may be had as "Style S1" in capacitance from 2 to 10,000 uuf.; "Style S2" in capacitances from 2 to 2000 uuf.; "Style RLR and Style RLA" with radial or axial lead ribbon leads, 4 to 7500 uuf. All available in ceramic bodies ranging in dielectric constant from 16 to 6000.—*Mucon Corp., 9 St. Francis St., Newark 5, N. J.*



For more information circle **330** on inquiry card.

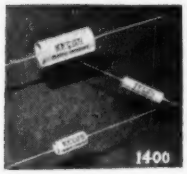
Vacuum Capacitors

New line of high-energy-content vacuum capacitors comprises five types all with the same dimensions and all rated for 35,000 volts peak, 100 amps. rms. Among features: Exhaust tube seal-off tip not exposed; wide-circumference low-resistance contact provisions; oxygen-free high-conductivity copper for all internal active area as well as for terminals. Capacitance values are 250, 200, 150, 100 and 50 mmfd.—*United Electronics Co., 45 Spring St., Newark 2, N. J.*

For more information circle **331** on inquiry card.

Plastic Film Capacitors

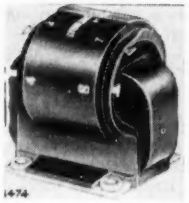
New "Type MH" is said to be a line of high-quality close-tolerance miniature plastic-film capacitors, utilizing moisture-proof DuPont "Mylar" polyester film; availability in close tolerances (to 1 percent) in any value from 0.01 to 1.0 ufd on a "delivery and price schedule comparable to what is customarily offered in standard values only." Voltage ratings 200, 400 and 600 v.dc. in standard miniature case sizes; larger values and special size cases to order. —*Dep't A1, Electronic Fabricators, 682 Broadway, New York 12, N. Y.*



For more information circle **332** on inquiry card.

Molded Transformers

New "Clipper" molded open type transformers pass MIL-T-27 specs, including Grade I humidity tests; operate continuously at 175 C. (Class H). This is said to be "the first time in the history of the field that open transformers have been built to pass these specifications.—*Sterling Transformer Corp., 297 N. 7th St., Brooklyn 11, N. Y.*



For more information circle **333** on inquiry card.

Line-bridging Transformer

New "Model 122" line-bridging transformer converts most makes of voltmeters from single-ended to balance input; plugs into input terminals

of voltmeters, and is compensated so readings are corrected for transformer's small insertion loss. It is supplied for bridging measurements on systems of the following impedances: "122A," 135 ohms; "122B," 500 ohms and "122C," 600 ohms. Each comprises a broad-band ferrite core unit operating flat within 0.5 db from 15 kc. to 500 kc.—*Sierra Electronic Corp., 1050 Brittan Avenue, San Carlos 2, Calif.*

For more information circle **334** on inquiry card.

Wire-wound VDR

New "Series 43c Control" is an improved version of maker's 1⅛-in. diameter ("Series 43") wire-wound voltage-dividing resistor. Features include an improved wiper arm contact and end termination, yielding higher resolution, more intricate tapers and tighter tolerances in over-all resistance and linearity, than previous models. Units available in values from

how CHACE THERMOSTATIC BIMETAL GUARDS AGAINST FIRES IN FireStaT

A Product of
The FireStaT Co.
Wheaton, Ill.

One of the simplest and most economical, completely effective automatic fire detection units is the FireStaT, actuated by two Chace Thermostatic Bimetal elements. Because of its low cost, many units can be used to protect a wide area economically, and as an open circuit is used there is no cost of operation.

A unit is located in an area to be guarded and connected in series with a power supply of 24 volts or less, and a warning device such as a light or bell. Where higher powered warning devices are indicated, or where a long line is required, the FireStaT is connected to a relay to step up the power.

The two Chace Thermostatic Bimetal elements give double protection. At an increase in ambient temperature the elements deflect toward each other. As the tip of either element touches the other, the circuit is closed. Increase in temperature brings both tips more forcibly in contact and in a sliding action, giving a positive double contact. Thus, a dependable warning signal is assured. FireStaTs come in standard models which give warnings at 140, 190, or 250 degrees F.

This illustrates but one of the many applications of Chace Thermostatic Bimetal as the actuating element for temperature responsive devices. If your product responds to, indicates or controls temperature changes, actuate it with dependable Chace Thermostatic Bimetal. Write today for our new 36-page booklet, "Successful Applications of Chace Thermostatic Bimetal", containing condensed engineering data and information.

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For more information circle **80** on inquiry card.

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1/4	100	P-114	$8.25
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HEXACON — Industry's No. 1 Soldering Iron

For more information circle **81** on inquiry card.

NEW INSTRUMENTS

1 ohm to 10,000 ohms; 2-watt rating; taps and various tapers; with or without switch; single, dual and triple assemblies; choice of shafts. Offered only as initial-equipment units for the present.—*Clarostat Mfg. Co., Inc., Dover, N. H.*

For more information circle **335** on inquiry card.

360-elec.-deg.-rotation Miniature VDR

New "D-100 Precision Potentiometer" is available with up to 360 degrees electrical rotation as well as mechanical rotation, in resistance ranges up to 50,000 ohms. Unit weighs 0.5 oz.; has anodized aluminum case ⅞ in. diam.; phosphor bronze bushing; ⅛ in. diam. stainless steel shaft (ball bearings if specified); Paliney contact material; rotor take-off brushes of gold alloy rotate on a coin-silver ring. Life "in excess of one million cycles of noise-free operation." Rating 1 watt at 25 C.; resistance alloy temperature coefficient 0.00002 parts per C. degree for values of 500 ohms or more. Ambient temperature rating −67 F. to 250 F. Terminal board material withstands 250 F. Terminals are available in silver or gold plating. —*Jet Electronics, Inc., 93 Massachusetts Ave., Boston, Mass.*

For more information circle **336** on inquiry card.

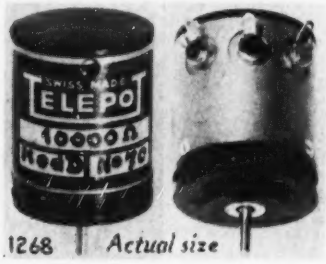
High-voltage VDR

New "Series 51" high-voltage high-resistance 2½-in.-diam. 1-watt composition-element variable resistor is housed in low-loss phenolic case with a phenolic disk back that widely separates terminals for maximum insulation; withstands 10,000-v.dc. breakdown test between terminals and mounting bushing; available values from 5000 ohms to 50 megohms linear. Tapers available to meet requirements. —*Clarostat Mfg. Co., Inc., Dover, N. H.*

For more information circle **337** on inquiry card.

Miniature VDR

New "Model D Telepot" Swiss-made ball-bearing wire-wound resistor features low torques: 0.003 oz-in. starting and 0.0015 oz.-in. running. Other



characteristics: 0.1 percent linearity; 100 to 100,000 ohms range with 2 to 3 percent tolerance; 0.5 watt rating; 360-deg. mechanical rotation and 355 + 5 deg. electrical rotation; 1200 rpm. max. operating speed.—*F. H. Paul & Stein Bros., Inc., 100 Gold St., New York 38, N. Y.*

For more information circle **338** on inquiry card.

Wire-wound Resistors

New "N-Caps" are encapsulated in a hermetically-sealed, plastic jacket; exceed specification MIL-R-930; are said to "retain their original characteristics over long period." Government sizes now available: RB 15, 16 17, 18, 19 and RB 52 series.—*Eastern Precision Resistor Corp., Richmond Hill 18, N. Y.*

For more information circle **339** on inquiry card.

Precision W-w. Resistors

New "Series H" of maker's "Type 10 Accurate Wire-wound Resistors" are molded in plastic, have rating of ¼ watt at ambient temperatures to 125 C. Dimensions are ¼ in. diam. by 13/32 in. long. Supplied in resistances from 0.1 to 300,000 ohms at tolerances as close as 0.05 percent.—*Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.*

For more information circle **340** on inquiry card.

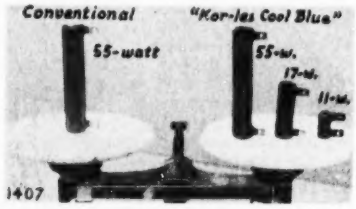
Power Resistors

New "Types PW-7 and PW-10" high-temperature resistors, unique in their rectangular shape, have been designed to allow a high degree of automatic assembly at a low cost. In ceramic cases, wire elements are uniformly and tightly wound on glass fibre cores with axial leads 1½-in. long; 0.036 in. diam. Body dimensions "PW-7," 1-25/64 in. long, ⅜ in. wide, 11/32 in. high; "PW-10," 1⅞ in. long, ⅜ in. wide, 11/32 in. high. "PW-7" is available from 0.51 to 5100 ohms; "PW-10" from 1.0 to 8200 ohms. New units are recommended for circuits requiring actual dissipation of 7 or 10 watts or less.—*International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.*

For more information circle **341** on inquiry card.

Coreless Power Resistors

New "Kor-les Cool Blue" weight-saving coreless power resistors, the first designed to meet Characteristic V of MIL R26B specs, will be avail-



able in standard resistance values within MIL types RW 29, 30, 31, 32, 33, 34 and 35. A ceramic refractory material completely encloses wire windings; coating is non-organic vitreous enamel permitting operating temperatures to 350 C.; all materials have a matching coefficient, hence no risk of internal stress build-up.—*Components Dep't, General Electric Co., Syracuse, N. Y.*

For more information circle **342** on inquiry card.

Control Resistors

New "Series 47 Twisted Tab Control" is electrically the same as maker's "Series 47" but reduced in cost. Twisted tab mounting eliminates

A.C. or D.C. Feedback with DIEHL

LOW INERTIA SERVOMOTORS AND INTEGRALLY-MOUNTED TACHOMETERS

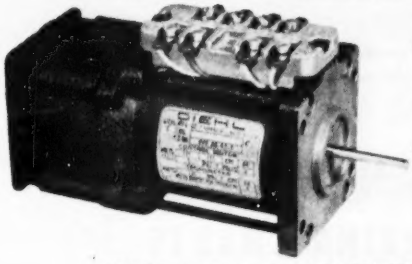
Response and stabilization of *Positioning Systems* can be improved with the Diehl Servomotor and *A.C. Tachometer*.

Analog System integration is facilitated by the use of the Diehl Servomotor with *D.C. Tachometer* combination.

Save space . . . and eliminate coupling problems and backlash . . . with these integrally combined units, motor and generator on the same shaft.

Diehl 5-watt output, 2-phase, 115/115 volt, 60 cycle, 2-pole Low Inertia Servomotors are available with a drag-cup type A.C. generator or with a permanent magnet D.C. generator mounted on the Servomotor as an integral unit, as illustrated:

MOTOR WITH A.C. TACHOMETER—NO. S.S. FPE25-67-1



Stalled torque: 5.0 oz. in.
Rotor moment of inertia: 0.18 oz. in.²
Tachometer output: 6 volts/1000 R.P.M.

MOTOR WITH D.C. TACHOMETER—NO. S.S. FPE25-86-1

Stalled torque: 5.0 oz. in.
Rotor moment of inertia: 0.18 oz. in.²
Tachometer output: 6.5 volts/1000 R.P.M.

These units are also obtainable for 10 watts output. Both the 5 and 10 watt units can be supplied with control windings for operation directly from the plates of vacuum tubes, or for 400 cycle operation.

Our engineering staff will gladly help you select the units best suited to your specific requirements. A request on your letterhead will bring you a copy of Technical Manual No. IN-0254 describing Diehl Servomotors and related equipment.

Other Available Components:
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MINIATURE PERMANENT MAGNET D.C. MOTORS

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DIEHL MANUFACTURING COMPANY
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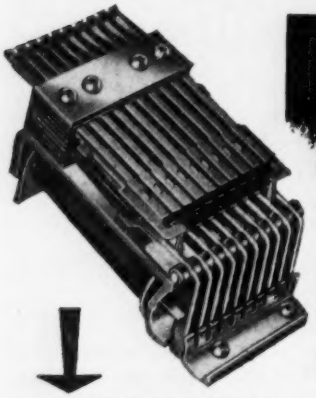
Atlanta Baltimore Boston Chicago Detroit New York Philadelphia Worcester

For more information circle **82** on inquiry card.

A Sequential Relay That Counts, Stores or Remembers



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SEQUENTIAL OPERATION—10 operations in sequence *but one relay pulse coil*
DIGITAL STORAGE—Once read-in, stored without power *but no latches*
TELEMETERING—Counting or controlling from a distance *but minimum wiring*
COMPUTERS—Series read-in parallel read out
STEPPING—Replaces 2 magnet 10 point stepping switch at *pulse rates up to 20 per second*

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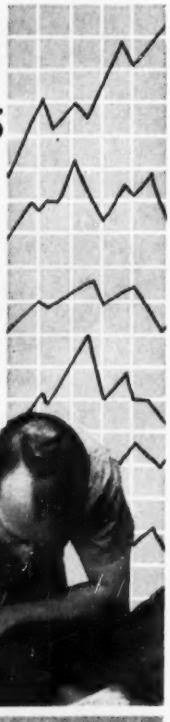

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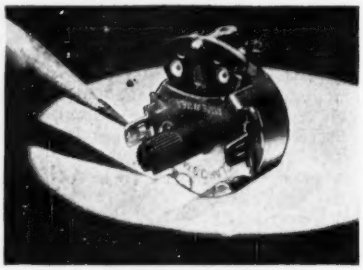
For more information circle **84** on inquiry card.

NEW INSTRUMENTS



usual bushing, lockwasher and nut. Unit is mounted by inserting tabs through slots in panel or chassis, and twisting them to secure it in place.—*Clarostat Mfg. Co., Inc., Dover, N. H.*

For more information circle **343** on inquiry card.

Kinescope

New "21ZP4-A" rectangular glass picture tube utilizing magnetic focus and magnetic deflection has a screen size of 19.12x14.19 in. with slightly curved sides and rounded corners; 70-deg. diagonal deflection angle.—*Tube Dep't, Radio Corporation of America, Harrison, N. J.*

For more information circle **344** on inquiry card.

Sealed Germanium Diodes

Six new crystal diodes, of germanium point-contact type, utilize sealed-in-glass construction. "1N34-A" is a general-purpose type for low-

power rectification in isolating, clipping, and switching circuits, etc. "1N38-A" is a large-signal type suitable for electronic computers and clamping circuits. "1N54-A" is a high-back-resistance type for clipping circuits, high-impedance detector circuits and high-voltage probes, etc. "1N55-A" is a large-signal type having a high peak inverse voltage rating, suitable for electronic computers, clamping circuits, d-c. restorer circuits, and high-voltage probes. "1N56A" is a high-conduction type featuring exceptionally low dynamic impedance. "1N58-A" is similar to "1N55-A" but has a somewhat lower peak inverse voltage rating.—*Tube Dep't, Radio Corporation of America, Harrison, N. J.*

For more information circle **345** on inquiry card.

Sealed Germanium Diodes

New germanium diodes are hermetically sealed, of solder-in design smaller in size than maker's previous models. New plug-in construction is also available. Mechanically, new diodes are more rugged and shock-resistant than maker's previous models. Quality is maintained by a 12-hour high-temperature (105 C.) test, a 4-hour low-temperature (–25 C.) check,

32 hours of temperature-humidity cycling and complete electrical tests for every diode.—*Receiving Tube Div., Raytheon Mfg. Co., 55 Chapel St., Newton, Mass.*

For more information circle **346** on inquiry card.

ELECTROMECHANICAL COMPONENTS

Sequence Relay

New "Frame 211" midget sequence relay, with a variety of dp-st. and dp-dt. contact arrangements, finds use wherever a predetermined cycle of operation is needed. A unique double cam movement permits contacts to be adjusted to operate when coil is de-energized when so specified. Cam rotates a half-step when coil is energized, and completes step when de-energized. Ability to transfer contacts on either "operate" or "release" phase is said to offer sequence arrangements never before practicable in a simple inexpensive unit.—*Struthers-Dunn, Inc., 150 North 13th St., Philadelphia 7, Pa.*

For more information circle **347** on inquiry card.

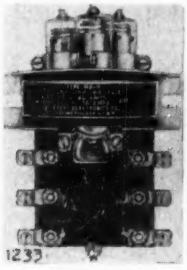
Heavy-duty Relay

New "Part No. 9191" is said to be a compact, lightweight, rugged relay for handling heavy contact loads with low coil power requirements. Double break contacts provide a large gap to extinguish arcing associated with heavy loads. Contact rating (resistive and inductive) 30/20 amp., 115/230 v.a.c. 1½/3 h.p., 115/230 v.a.c. Coil rating (continuous duty a.c.) 8.5 va., 60 cps.; d.c. 4.4 watts. Weight 6.4 oz.—*Leach Relay Co., 5915 Avalon Blvd., Los Angeles, Calif.*

For more information circle **348** on inquiry card.

Heavy-duty Mercury Relay

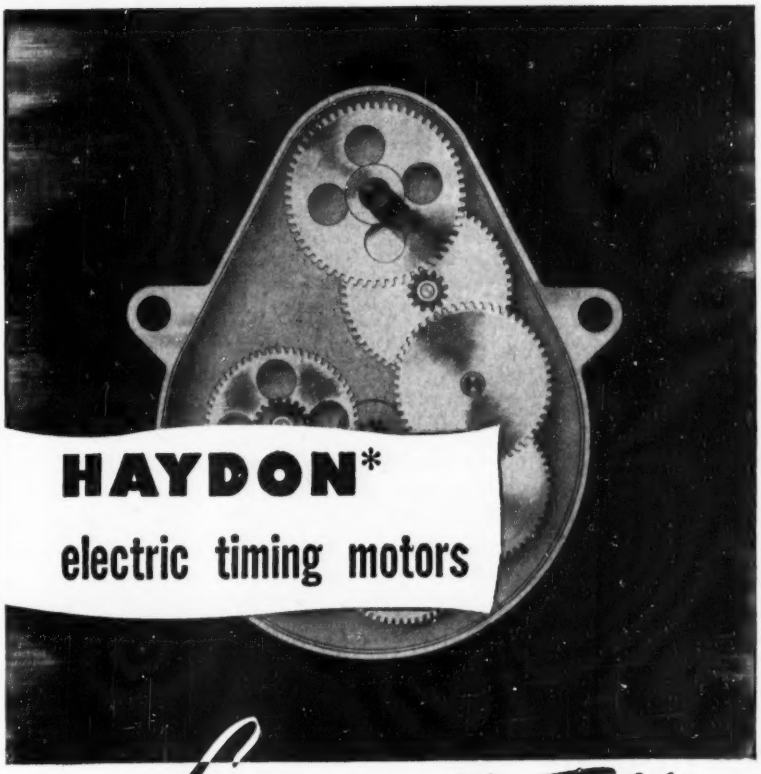
New "Relay HD-7" is a three-tube relay for heavy-duty control applications. Each mercury-contact tube can control up to 60 amps. at 115 v.-ac. and 35 amps. at 230 v.ac. D-c. control capability per tube is 12 amps. at 115 v. Each tube can control 2 hp. at a.c. and 0.5 hp. at d.c. Coils are obtainable for a variety of control voltages. Rating for normally-open operation is 5 hp. at 230 v.ac., 3 phase; 10 hp. at 440 v. 3 phase. For special applications, any combination of N-O and N-C tubes can be supplied. —*Ebert Electronics Co., 212-26 Jamaica Ave., Queens Village 28, L.I., N. Y.*



For more information circle **349** on inquiry card.

Snap-action Switch

New "Type MXT-1" switch, said to provide accurate repetition of operate point, utilizes a rigid lever arm pivoted on a bearing pin set in supports integral with molded cover. Actuating arm can be furnished in



Leaders in the Field

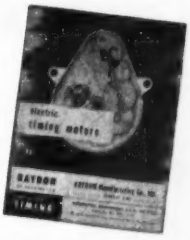
OF TIMING COMPONENTS

HAYDON, in addition to its own extensive development, engineering and production facilities has the backing of the basic research facilities of the General Time Corporation. The wide experience of associated companies, Westclox, Seth Thomas, Stromberg Time and Western Clock are also available.

These wide resources have resulted in HAYDON's unquestioned leadership in the field of timing.

Write for Catalog No. 322, Electric Timing Motors

Other literature available on request on Timing Devices, Clock Movements, 400 cycle Elapsed Time Indicators, 400 cycle Time Delay Relay, 400 cycle Motors, D.C. Motors.



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For more information circle **85** on inquiry card.

When your problem involves drying air to obtain more efficient, dependable instrument operation, the Industrol Dynamic Dehumidifier offers you a practical low cost solution.

Dryers are offered with manual, semi-automatic or fully automatic control. Heat regeneration of desiccant is supplied by either electricity or steam.

An Industrol Dynamic Dehumidifier used in conjunction with the Industrol Centrisorb Filter is the ideal combination to give you the clean, dry air that spells trouble-free instrument operation.

Prove to yourself why more plant operating men are specifying Industrol. A qualified engineer is available to consult with you on your dryer problems.

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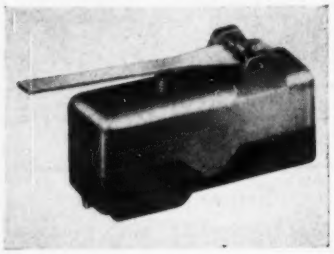
For more information circle **87** on inquiry card.

NEW INSTRUMENTS



any desired length and with special bends. Actuator can be modified, by eliminating coil spring, to permit operation at forces down to 15 grams; this version is designated "MBT-1." Rating, 15 amps. at 125 v.ac.—*Unimax Switch Div., The W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y.*

For more information circle **350** on inquiry card.

Waterproof Plunger Switch

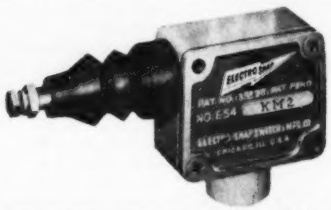
New "Part 201209" switch is completely waterproofed. Small rubber plunger can be fabricated in accordance with customer's specifications.

Overtravel is an inherent characteristic. Bracket is one-piece construction; no bolts or nuts to corrode. Available in s.p.s.t. or s.p.d.t. contacts.—*Control Products, Inc., 306 Sussex St., Harrison, N. J.*

For more information circle **351** on inquiry card.

One-way Impulse Switch

New "ES4-KM2" snap-action switch featuring one-way impulse action is said to "render control performances never before achieved by a single

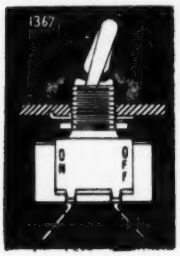


switching component." It can obviate need for time delay relays, etc. Example: in a switching operation where a pulse to a solenoid or starter is needed, it sends controlling electrical impulse and then drops out of circuit, allowing solenoid valve to return after it receives an impulse from circuit controlling return solenoid. Choice of five "on" periods: from 1/16 in. to 3/8 in. Switch completes circuit for a predetermined part of plunger's forward stroke, then gives release to impulse as the plunger advances. Basic switch is s-p.d-t. type for a-c.; 2-circuits n-o. or n-c.—*Electro-Snap Switch & Mfg. Co., 4218-30 W. Lakes St., Chicago 24, Ill.*

For more information circle **352** on inquiry card.

Toggle-Switch Boot

New "Model 5030 Hexseal" for subminiature switches, added to maker's line of toggle-switch boots for high pressure service, affords hermetic sealing and fastening in one unit when installed on exterior of a panel in place of a conventional locknut. "Hexseals" are made of silicone rubber chemically bonded to a threaded insert; meet vibration and weather requirements of MIL Spec E-5272A and surpass requirements of MIL Spec B-5423.—*Automatic & Precision Mfg. Co., 252 Hawthorne Ave., Yonkers 5, N. Y.*



For more information circle **353** on inquiry card.

Dynamotors

New "Change-A-Volt" dynamotors are for 6-volt mobile radio operation (up to 30 watts) in new cars equipped with 12-volt batteries; are supplied complete with starting relay and switch, 12-volt fuse block, and conversion wiring.—*Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.*

For more information circle **354** on inquiry card.

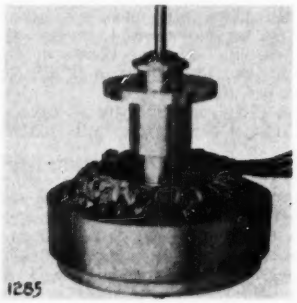
Miniature PM Motor

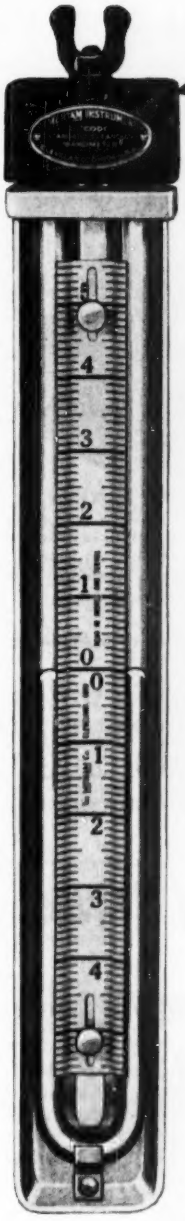
New miniature permanent-magnet motor or generator said to be ultimate in power output for its size (smaller than a standard pack of cigarettes) is available in horsepower rating from 0.004 to 0.0165, speeds from 2,000 to 20,000 rpm., weights from 3.5 to 9 oz. Basic motor conforms to JAN specs; optional features are watertight and explosion-proof housing, fungicided armature, noise filter, speed governor and gear reducer. Voltage range is 6 to 110 d.c. As a generator: at 6,000 rpm. 1.5 to 8 watts output range. Motor-generator combinations can also be supplied.—*The Pioneer Electric & Research Corp., Forest Park, Ill.*

For more information circle **355** on inquiry card.

"Inside-out" Motor

New "inside-out" hysteresis motor, for high-quality magnetic-tape recording equipment, etc., features a flywheel and precision tape drive capstan as a part of motor assembly. Concentric within 0.0001 in., capstan provides peripheral speeds of 7½ and





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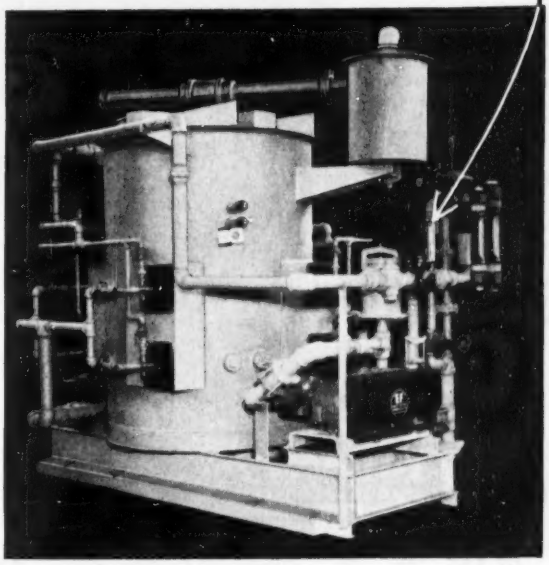

This EF Endothermic Type Special Atmosphere Generator, built by The Electric Furnace Company, Salem, Ohio, depends on Meriam Manometer accuracy to help produce an atmosphere that prevents decarburization of high carbon steel parts during heat treatment.

Proper combustion in this huge generator, requires an absolute pressure balance downstream of the air filter and the gas regulator. This balance is continuously indicated by the Meriam Manometer on The Electric Furnace Co. Endothermic Type Special Atmosphere Generator . . . providing essential information for a perfect atmosphere.

Sensitivity, ease of reading, comparative freedom from maintenance and manometer accuracy . . . these are the features customers tell us they prize most highly in Meriam Manometers.

Whatever your problem relating to pressure or flow indication, we believe we can be of service. Drop us a line or call your Meriam Technical Representative.

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VOLTS—.1 to 3,000 volts full scale.

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For more information circle **89** on inquiry card.

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AUTOMATIC CONTROL

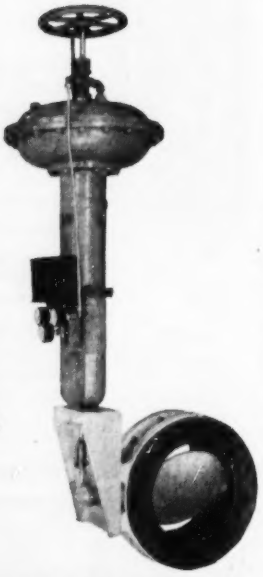
for quick opening and shut-off by motor, air operator, air or hydraulic cylinder or positioning for any desired flow rate.

RESISTANT CONSTRUCTION

of cast iron and steel, stainless steel, bronze, Hastelloy, or rubber-lined to withstand chemical or abrasive action.

DEPENDABLE OPERATION AT ANY TEMPERATURE OR PRESSURE

of air, gases, liquids and semi-solids at temperatures below freezing or as high as 2000° F., at pressures to 300 p.s.i.g. without clogging or breakdown. You can be sure—if you install Rockwell Butterfly Valves. Pipe sizes 1" to 4" threaded; 4" to 120" flanged or wafer types.



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For more information circle **90** on inquiry card.

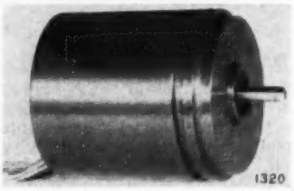
NEW INSTRUMENTS

15 ips. at synchronous speeds of 600 and 1200 rpm., respectively. Full-load torque rating (conservative) 12 in.-oz. Combination rotor and 5-in. flywheel consisting of a thin magnetic ring encased within a zinc alloy housing revolves outside a stationary split-phase primary winding. Utilization of near-maximum motor diameter for diameter of rotor ring greatly amplifies magnetomotive torque transfer maintaining synchronous operation under high loads.—*Technical Development Corps.*, 4060 *Ince Blvd., Culver City, Calif.*

For more information circle **356** on inquiry card

Miniature Resolver

New "Size 15 Telesyn Resolver" miniature computing unit, of rotatable-transformer type, continuously performs trigonometric operations in-

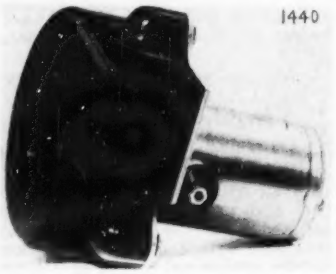


volving resolution of input voltages into sine and cosine components. Available in three models with transformation ratios of 1:1, 4:1, and 8:1, for applications in analog computers, angle data transmission systems, automatic control systems, etc.; also can perform synthesis of two voltages and rotation of coordinates. Unit is rated at 1-24 volts, 400-cps. input.—*Ford Instrument Co.*, 31-10 *Thomson Ave., Long Island City* 1, *N. Y.*

For more information circle **357** on inquiry card.

PM Motor and Blower

New permanent-magnet dc. motor and centrifugal blower for instrument cabinets, control enclosures, etc.,

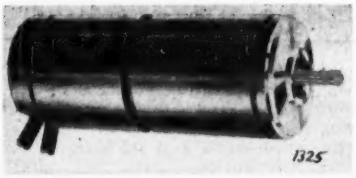


weighs 7.5 oz.; has an air volume of 20 cfm. free air; measures approx. 2-⅞ in. at blower end; motor diam. is 1-¼ in.—*Mission-Western Engineers, Inc.*, 132 *Colorado Blvd., Pasadena* 1, *Calif.*

For more information circle **358** on inquiry card.

Servomotor Generator

New "Type R804" two-phase servomotor and integral damping generator weighs 7.6 oz.; is 1.062 in. in diam. and 3 in. long, yet features extremely low rotor inertia and high stall torque. Motor excitation is 115-

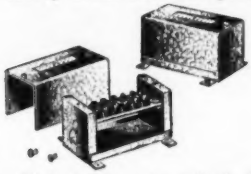


volt 400-cps. for fixed phase; 57.5-volt 400-cps. for center-tapped control phase; draws 3.5 watts. Motor output: rotor inertia is 1.3 gm.-cm.^{2}; stall torque 0.63 in.-oz.; no-load speed 5900 rpm.; theoretical acceleration at stall is 34,2000 rad/sec.^{2}. Generator excitation is 115-volt 400-cps.; output is 0.5 volt per 1000 rpm. minimum; output impedance 600 ohms.—*Kearfott Co., Inc.*, 1150 *McBride Ave., Little Falls, N. J.*

For more information circle **359** on inquiry card.

Terminal-block Enclosure

New metal enclosure alleviates conditions of excessive dust and provides safety from shock to personnel

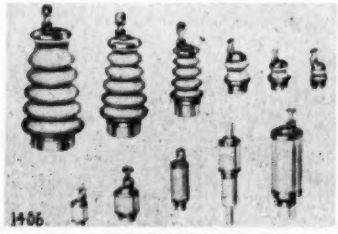


where high-voltage terminal blocks must be mounted near avenues of traffic. It comes with maker's "M" or "MT" terminal blocks integrally mounted with from 1 to 14 terminals per block and enclosure. Available in minimum quantities of 100 units for the present.—*Curtis Dev. & Mfg. Co.*, 3266 *N. 33rd St., Milwaukee 16, Wis.*

For more information circle **360** on inquiry card.

Hermetic Terminals

New "Metalized Solderseal Hermetic Terminals" are made of alumina ceramics (new material conforming to requirements of Grade L-5A in



accordance with JAN-1-10). Lugs and eyelets are hot-tinned brass with metalized areas silver-fired on ceramic; are copper electroplated and tin-fused for soft soldering.—*General Ceramics and Steatite Corp., Keasbey, N. J.*

For more information circle **361** on inquiry card.

Miniature Shielded Cables

New "super-flexible" miniature shielded cables are available with outer jacket of Teflon, protecting against mechanical damage while electrically insulating metallic shield. Single and multi-conductor types with conductor sizes from No. 20 to 30 AWG. Continuous operation at tem-

the Waterman

WIDE BAND

POCKETSCOPE®

MODEL S-14-B

Size:
12" x 6" x 7"
14 Pounds

ANOTHER EXAMPLE OF Waterman PIONEERING...

The WIDE BAND POCKETSCOPE, model S-14-B, hits a new high in frequency response for light, compact, truly portable oscilloscopes. The response extends all the way from DC to 700 KC within —2 db without peaking. Thus providing a pulse rise time of 1.8 microseconds. Furthermore, sensitivity has not been unduly compromised in order to accomplish such fidelity. The vertical sensitivity is 50 millivolts rms/inch. The sweep is operated in either a repetitive or trigger mode and covers a range from 0.5 cycles to 50 KC with synchronization polarity optional. Other essential vertical and horizontal amplifier characteristics include non-frequency discriminating attenuators and gain controls as well as individual calibration voltages. Additional provisions for direct access to all the deflection plates, the second anode, and the amplifier outputs help to make the S-14-B a standout instrument of flexibility and utility. All this plus portability! The incredibly small size and light weight of the S-14-B now permits "on-the-spot" use of the oscilloscope in all industrial, medical, and communications fields. Its rugged construction assures "laboratory performance" regardless of environment.

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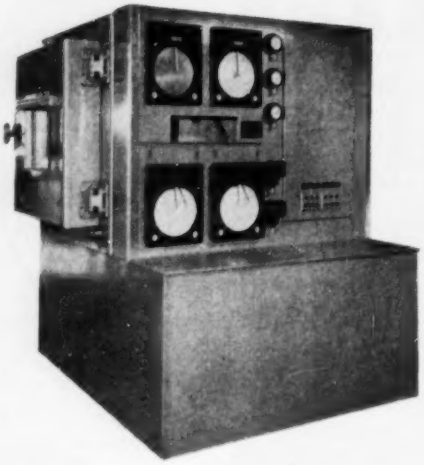
For more information circle **91** on inquiry card.

TEST CHAMBERS



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- +200° F. to −150° F.
- 20% to 95% R.H.
- 1 cu. ft. to 75 cu. ft. cabinets

Walk-in Rooms
Temperature Baths

Electronic or pneumatic recording or indicating control system

CUSTOM CHAMBERS built to specifications.

Standard CABINET COMPANY

Years of satisfactory service!

52 Washington Avenue

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For more information circle **92** on inquiry card.

Pneumatic Weight Transmitters

FOR LINEAR CONVERSION OF WEIGHT INTO POUNDS PER SQUARE INCH AIR PRESSURE

A complete line of weight transmitters in single and multiple diaphragm construction with load capacities up to 23,000 pounds per diaphragm. Pneumatic tare balance for any portion of the total load on all models. All moving parts are enclosed totally. Complete weighing systems designed to your requirements.

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JOHN R. MONSELL
Manufacturing Engineer
Pitman, N. J.

For more information circle **93** on inquiry card.

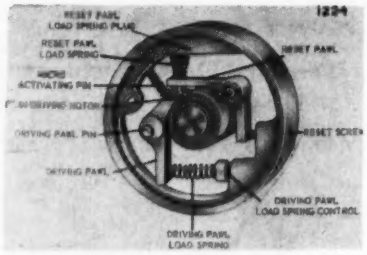
peratures from −90 C. to 250 C. with maximum operating voltages to 1000 volts rms.—*Tensolite Insulated Wire Co., Inc., Tarrytown, N. Y.*

For more information circle **362** on inquiry card.

MECHANICAL COMPONENTS

Torque-limiting Clutch

New "Overload Trig-O-Matic Clutch" is an overload-preventing safety device. It features instantaneous trigger action in torque limitation and is suited for speeds as low as 1

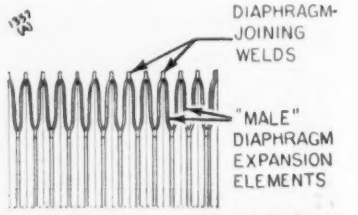


rpm. as well as for high speeds. When predetermined overload occurs, driving pawl slides out of notch in driving collar. Reset pawl at this point engages driving pawl in this released position and power is disengaged. To resume operation, reset screw is adjusted until driving pawl is released: machine will then resume operation at exact cycle point of release.—*Centric Clutch Co., Route 9, Woodbridge, N. J.*

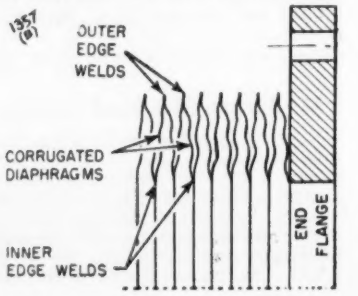
For more information circle **363** on inquiry card.

Metallic Bellows

New welded-diaphragm type of metallic bellows, in a variety of standard production sizes and materials, feature a new construction which distributes



flexing over entire height of each convolution, thus avoiding concentration of flexing and resultant work-hardening that leads to bellows failure. Advantages claimed over bellows of "con-



ventional" construction: (1) flexibility can be increased by increasing height of bellows convolutions and can be attained with metal of sufficient thickness so that these bellows for low-pressure lines can withstand high external pressures; (2) permits "much greater expansion" per inch of bellows length than is possible with "conventional" bellows. Two types: "standard," comprising a series of male expansion elements (Fig. A), and "nesting," comprising a series of nesting male-and-female expansion elements (Fig. B) for extreme flexibility applications.—*Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.*

For more information circle **364** on inquiry card.

Instrument Bearing

New "Micro R2" instrument ball bearing employs a ribbon-type balanced cone-controlled retainer which cannot wind up, hang up, or fall out. Result is said to be a low and repetitive starting torque in one bearing and from one bearing to another. New bearing has been tested at 90,000 rpm.; is available in flange-type and with straight O.D. as against older designs which had a taper. In torque tests, maximum break-away is 140 dyne-cm. with no special testing and a maximum of 100 with testing, based on a 75-gm. thrust load. New bearing is available also in stainless steel, and in angular contact construction with phenolic retainer. Tolerances are ABEC5 to ABEC7 and better.—*New Hampshire Ball Bearings, Inc., Peterborough, N. H.*

For more information circle **365** on inquiry card.

VALVES, TUBING, etc.

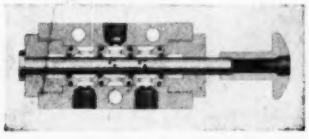
Diaphragm-motor Valves

New "Series 800" diaphragm-motor control valves, designed for use with wide-band proportional control instruments, feature a completely redesigned diaphragm motor with pressed steel case plates; yoke with mounting bosses on both sides for auxiliary equipment; a unique locking arrangement for securing body stem to spring stem, and either bolted or screwed stuffing boxes. New line includes direct-acting, reverse-acting and springless diaphragm motors, for operation of either double- or single-seated straight-through bodies or for Venturi, three-way and low-flow types of bodies. Available with new valves is a line of solid, V-ported, double-seated plugs, and an additional spring range of 6 to 30 psi.—*Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa.*

For more information circle **366** on inquiry card.

Small Control Valves

New control valves feature unique interior construction that assures positive positioning of sealing packers without placing any mechanical pres-



MINIATURIZING YOUR EQUIPMENT?

Specify SIMPLEST, MOST COMPACT

AMPERITE THERMOSTATIC DELAY RELAYS

MOST ECONOMICAL, HERMETICALLY SEALED

STANDARD

MINIATURE

Provide delays ranging from 2 to 120 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- *Hermetically sealed.* Not affected by altitude, moisture, or other climate changes.
- Circuits: *SPST only* — normally open or normally closed.

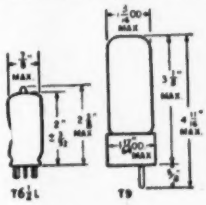
Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from —55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are *most compact, rugged, explosion-proof, long-lived,* and — *inexpensive!*

TYPES: Standard Radio Octal, and 9-Pin Miniature.

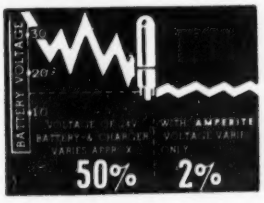
PROBLEM? Send for Bulletin No. TR-81

BALLAST-REGULATORS

- Amperite Regulators are designed to keep the current in a circuit ***automatically regulated*** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. *Operates on A.C., D.C., Pulsating Current.*
- Hermetically sealed, light, compact, and most inexpensive.



T6½L T9



T9 BULB

Maximum Wattage Dissipation: T6½L—5W. T9—10W.

Amperite Regulators are the simplest, most effective method for obtaining ***automatic regulation*** of current or voltage. ***Hermetically sealed,*** they are not affected by changes in altitude, ambient temperature (—55° to +90°C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

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AMPERITE CO. Inc., 561 Broadway, New York 12, N. Y.

In Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto 2B

For more information circle **94** on inquiry card.

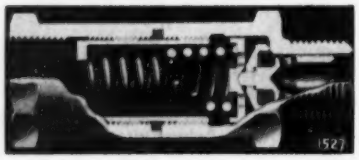
NEW INSTRUMENTS

sure on packers themselves. Principal parts comprise a housing with straight-through bore; gland nuts for ends; a hollow radially-ported polished stainless steel plunger; internal spacers held firmly in metal-to-metal end abutment; and two sizes of "O" rings. Construction is said to minimize friction; there are no lapped joints and no metal-to-metal seating. Available in push-pull, push spring return, hand, foot, cam, diaphragm, pilot, and single- or double-solenoid operated, with 2-, 3-, 4- or 5-way actions and either open or closed exhaust. Furnished tapped for either ⅛ or ¼ in. pipe connections; for use in either air or hydraulic service, pressures to 125 psi., temperatures to 150 F., also in vacuum service.—*C. B. Hunt & Son, Inc., Salem, Ohio.*

For more information circle **367** on inquiry card.

Relief Valve

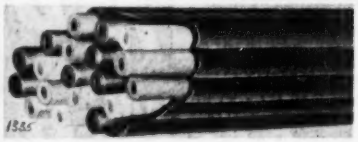
New "Series 5100" relief valves feature adjustment of cracking pressure within 15 percent of nominal by means of a standard Allen wrench; and interchangeable replacement springs for a wider range of adjustment. Performance curve shows a slight regular increase in pressure drop with increasing flow rate, serving to stabilize action and prevent chatter. Available for pressures from 50 to 1000 psi.; male inlet and female outlet pipe threads; sizes ¼-in. to 1-in.—*James-Pond-Clark, 2181 E. Foothill Blvd, Pasadena 8, Calif.*



For more information circle **368** on inquiry card.

Color-coded Tube Harness

New color-coded lines simplifying installation are available for maker's "Impervak Poly-Cor" instrument-tubing harness. Individual lines are coded

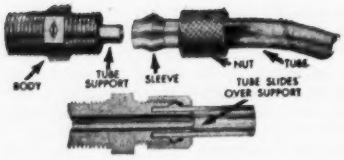


in black, red, blue, or green (other colors on special order). Harness is composed of a bundle of 4, 7, 10, 14 or 19 polyethylene tubes over which is extruded a 1/16-in. sheath of high-molecular-weight vinyl plastic.—*Dekoron Tubing Div., Samuel Moore & Co., Mantua, Ohio.*

For more information circle **369** on inquiry card.

Fittings for Plastic Tubing

New "Poly-Flo" fittings, for connecting polyethylene and other plastic tubing, save installation time as fitting need only be finger-tightened and



tubing can readily be bent by hand; consist of a brass body with integral tube support, brass nut and polyethylene sleeve; can also be supplied in stainless steel; are said to be exceptionally well adapted to instrumentation, to food and beverage industries, laboratories, etc.—*Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.*

For more information circle **370** on inquiry card.

FOR INSTRUMENT SHOP

Surface Roughness Scale

New "S22 Microfinish Comparator," placed alongside machined work, provides by eye or by touch a quick and positive comparison for quality and workmanship. It has 22 different established flat-surface roughness specimens for visual and tactual com-

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Department I-3

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parisons ranging from 2 to 500 microinches, and conforming to ASA standards. Accuracy is obtained by electro-forming process which, using a single precision-machined master, assures uniformity of each specimen and avoids variations.—*Baptist Machine Co., Ludlow St., Stamford, Conn.*

For more information circle **371** on inquiry card.

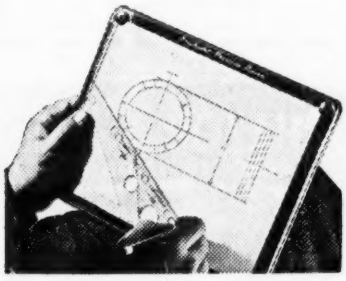
Magnetic-chuck Blocks

New "Magne-Blox" line of magnetic parallels and V-blocks in all sizes and shapes is said to be complete; and blocks are said to be "so inexpensive that it is not worth the time and material to make one's own." "Magne-Blox" are manufactured of alternate laminations of 1/16-in. brass and 3/16-in. high-magnetic-capacity iron; may be used on all types of magnetic chucks, including permanent-magnet type. Ordinarily, for an accurate grinding set-up, magnetic chuck has to be re-ground; by grinding "Magne-Blox" instead, life of chuck is prolonged indefinitely.—*George Scherr Co. Inc., 200 Lafayette St., New York 12, N. Y.*

For more information circle **372** on inquiry card.

Portable Drawing Board

New portable drawing board molded of clear polystyrene plastic weighs less than 8 oz.; has four corner clamps for attaching 8½x11 paper without

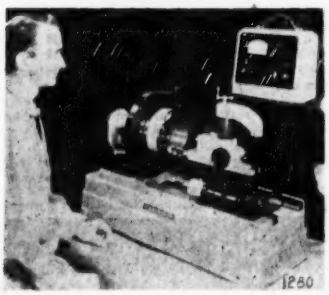


thumbtacks. Clamps are recessed into plastic so that a triangle or ruler can ride over them. Two metal straight edges, one horizontal, one vertical, are retractable. Tension clamps on under side provide for secure storage of triangles.—*The Graphostat Co., 110 Eaton Place, East Orange, N. J.*

For more information circle **373** on inquiry card.

Ring-gage Inspector

New bench-type precision measuring instrument gages lead, taper, straightness and concentricity of straight and tapered plain and thread



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★ Exceptional resistance to shock and vibration.
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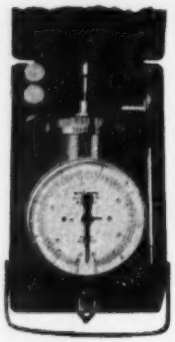
Indispensable in Laboratories, Industrial and Power Plants.



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- Engines
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Model A	30—12,000 RPM
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Linear speeds in feet per minute can also be measured by using the cut-meter wheel.

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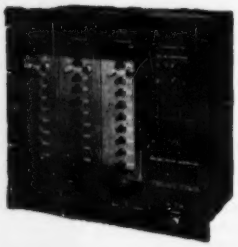
SQUARE PULSE GENERATOR

MODEL 300



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MILLIMICROSECOND to MICROSECOND RANGE

New Basic Test Instruments for NUCLEAR, RADAR, TV, UHF, and other fields in which FAST PULSE CIRCUITS are employed. Three or more pulse outputs are available in Model 300.

SPECIFICATIONS

PULSE SHAPE: square pulse
RISE TIME: .001 μsec. from 10% to 90% amplitude
PULSE WIDTH: .001 μsec to several μsec. selectable
PULSE AMPLITUDE: From 100 volts to .006 volts in one db steps
OUTPUT IMP: Matched to any impedance for standard coax lines
POWER INPUT: 105-125 V, 60 cy.
SIZE: 17-1/2" x 19" x 10-3/16"

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For more information circle **100** on inquiry card.

NEW INSTRUMENTS

ring gages up to 8 in. max. I.D. and 10 in. max. O.D. It comprises a rigid cast iron base on which is mounted a rotating face plate, a pickup stylus on a gaging arm adjustable vertically on a column mounted on a ball-bearing slide, a micrometer screw for use with precision end measures, and an electronic amplifying (2000×) indicating unit. Rotating face plate can be swung through a 90-deg. arc to come to rest upon a horizontal sine bar fixture. Interchangeable ball point gaging tips, sizes 0.030, 0.050, 0.080, and 0.125, permit gaging almost any thread.—*Sheffield Corp., Dayton* 1, *Ohio.*

For more information circle **374** on inquiry card.

Gear Analyzer

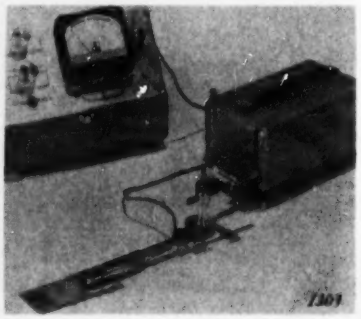
New "Gear Analyzer" checks a wide range of gear sizes and no master gear is required. Complete analysis of "running conditions" can be

made, even when gear operates with back-lash. Gear is viewed as it rotates in contact with and at the correct center distance from a composite rack chart (e.g., 14 to 180 DP). Thus analysis of gear is made by observing "running action" at a magnified projection on a "Model 3 Kodak Contour Projector."—*Optical Gaging Products, Inc.*, 26 *Forbes St., Rochester* 11, *N. Y.*

For more information circle **375** on inquiry card.

Reciprocating-stroke Drive for Surface-roughness-pickup

New "Model BL-114," tracing accessory for use with maker's "Surfindicator" which measures surface roughness, provides reciprocating-



MACHINES for MARKING & NUMBERING

HAND
MOTOR
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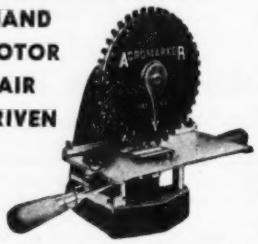
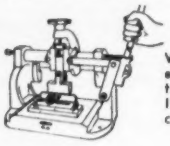
DRIVEN



"The most complete line of machines and tools for marking in AMERICA." Equipment for marking and stamping, embossing, printing and stenciling methods. Steel type, stamps, numbering and marking machines carried in stock.



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"the original marking specialists"

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Pat. Pend.

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A phase sensitive null detector wherein noise and harmonic voltages are effectively eliminated.

- For use in conjunction with bridge and potentiometer circuits.
- Simplified and precise zeroing of synchro devices.
- Allows separate adjustment of phase and magnitude in null circuits.
- Eliminates the necessity for filters.

SPECIFICATIONS

Input Impedance
High Gain—2 megohms shunted by 30 mmfd.
Low Gain—2.5 megohms shunted by 15 mmfd.
Sensitivity—6 millivolts off-scale deflection
Frequency Range—
30-10,000 cps (higher ranges available)
Selectivity—40 db. down on all noise & harmonics
Reference Input Power—10 milliwatts
Maximum Input Voltage—125 volts RMS
Peak Input Voltage—400 volts
Power Supply—105-125 volts, 60 cps, 25 watts
Dimensions—Hgt. 9 in., Width 15 in., Depth 8 in.
Weight—25 pounds

INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th ST., N. Y. 3 - Tel: GR. 3-4684

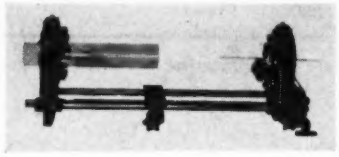
For more information circle **102** on inquiry card.

stroke movement of "Surfindicator" pickup along surface being inspected, and extends usefulness of "Surfindicator" beyond range practical with hand operation. Stroke length is adjustable from 2⅞ in. to less than 1/16 in.; stroke speed is ⅛ in. per sec. —*Equipment Div., Brush Electronics Co., 3405 Perkins Ave., Cleveland, Ohio.*

For more information circle **376** on inquiry card.

Glass Lathe

New "Lab-Lathe," said to be "the first of its kind designed for specialized glass work in the laboratory and certain types of production operations," features a unique sleeve-grip chuck which permits quick setups of practically all forms of glass work without elaborate accessories. Tubing of any length up to 100 mm. diam. can be mounted through spindle. Extension bars grip a variety of glass shapes in sizes up to 12 in. diam. with eccentric settings made as required. Unit can be adapted for use as a vertical lathe; has an automatic brake, floating burner carriage, nonwarping bed, pinion-bar drive full length of travel, and a 1/12 hp. 115-v.ac. motor. Normal chuck speed, 32 rpm. Net weight, 150 lbs.—*Bethlehem Apparatus Co., Front & Depot Sts., Hellertown, Penna.*



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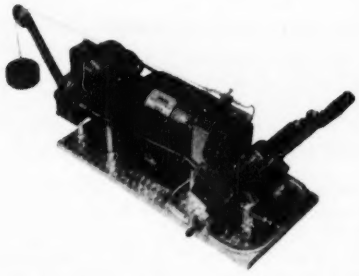
Optical Edging Machine

New "Productionaire" edger, for precision grinding and edging of lenses, reticles, quartz blanks and radio crystals, is said to be first low-cost optical edging machine assuring roundness within 0.0001 in. and maintaining diameters to 0.0005 in. in rapid production without prestacking. Operating costs are minimized by use of a small inexpensive cup type diamond wheel. Available in three sizes, each with controls and gaging devices permitting uniform production without operator variables.—*John Schaad & Sons, Byberry Rd., above Philmont Ave., Huntingdon Valley, Pa.*



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CANNON PLUGS

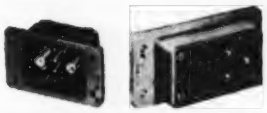
–the highest quality
–greatest variety
–widest use

AN Designed to Air Force–Bureau of Aeronautics – requirements. Now widely used for all instruments requiring electrical circuits. Coupling nut connection and disconnection. Two plug types; 3 receptacles with variations and clamp accessories, in 15 shell sizes and more than 250 insert arrangements. A type for every need. Ask for "AN" Bulletin.

K & RK Designed for uses in aircraft, this versatile lightweight plug is widely used on a great variety of instruments and electronic equipment. Special acme coupling nut connection and disconnection. 8 contact sizes accommodate 16, 14, 10, 8, 6, 4, 2 and 0 AWG. Maximum 200a. 8 shell diameters. 204 insert variations. KH Series, hermetically sealed Type K, also available. Write for "K" Bulletin.

GS (AN) Designed for applications demanding hermetic sealing under high pressures in a temperature range from minus 300F to plus 600F. 2 basic shell designs. NEF threaded coupling nut. Steel shells and steel contacts. Mate with AN Series. See "AN" Bulletin or "GS" Bulletin.

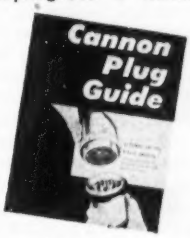
XL For audio equipment and general electronic uses; 3 and 4 contact layouts, 10 and 15a; 17 shell designs; zinc and steel plug shells. Ask for "XL" Bulletin.



DPB-DPD For rack-and-panel installations, instrument panels and for any plug-in sub-assembly where both halves of the connector are rigidly mounted, or where one half is rigidly mounted and the other half cord mounted. 78 max. contacts, 200a maximum. Ask for "DP" Bulletin.

D SERIES SUB-MINIATURE PLUGS
Designed to meet the miniaturization program. Used both as rack-and-panel disconnect and cord connectors for hand portable radio equipment, audio circuitry and related applications. Keystone shaped. 15 to 50 gold-plated contacts. DH hermetically sealed also available. See "D" Bulletin.

U SERIES SUB-MINIATURE PLUGS
For hermetically sealed instruments, indicators, miniature switches, relays, transformers, amplifiers and other miniaturized sealed components. Steel shells & pin contacts; standard socket contacts in Silcan insulators. 1, 3, 6, 12 contact arrangements. 5a max. Bayonet lock coupling. See "U" Bulletin.



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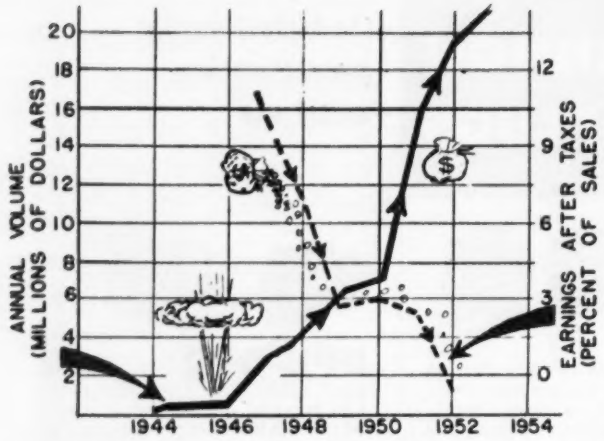


Annual volume is rising, but earnings are falling—reveals this survey of a representative cross-section of the American nuclear-instrument industry.

TABLE 1.—COMPANIES USED AS BASIS FOR ANALYSIS OF THE NUCLEAR-INSTRUMENT INDUSTRY.

Name	*Number of Stockholders, June 30, 1953.*	*Origin of Management*
Atomic Instrument Co.	400	Massachusetts Institute of Technology
Nuclear-Chicago	600	Metallurgical Laboratory (University of Chicago)
Radiation Counter Laboratories, Inc.	3	Metallurgical Laboratory (University of Chicago)
Radioactive Products, Inc.	1200	Massachusetts Institute of Technology
Tracerlab, Inc.	1300	Massachusetts Institute of Technology
Victoreen Instrument Co	2300	Prewar

The Economic Status of the

Nuclear-Instrument Industry

by ERNEST H. WAKEFIELD*

An analysis of the unfavorable profit-and-loss situation of a representative segment of the nuclear-instrument industry reveals ways in which improvements can be made. The economic status of this relatively new part of the field of instrumentation contains important lessons for every instrument company.

DOES FREE ENTERPRISE exist in the Government-sponsored nuclear energy field? With the United States Atomic Energy Commission investment now at approximately nine billion dollars and with AEC expenditure at an estimated two billion dollars from tax-derived sources in the fiscal year 1953, what is the economic status of that microscopic section of the nuclear energy commission controlled by private industry?

The only free-enterprise section of the nuclear energy field is the nuclear-instrument industry. A recent release from the AEC indicates that this industry had 1952 sales totaling an estimated twenty million dollars divided among some eighty companies, with six companies doing more than one half the business. How has this little segment of free enterprise fared in a field gigantically dominated by public expenditures? This major inquiry resolves itself into a few questions: (1) What is the make-up of the nuclear instrument industry? (2) What have been its earnings? (3) Who are its customers? (4) What have been its trends in the past six years?

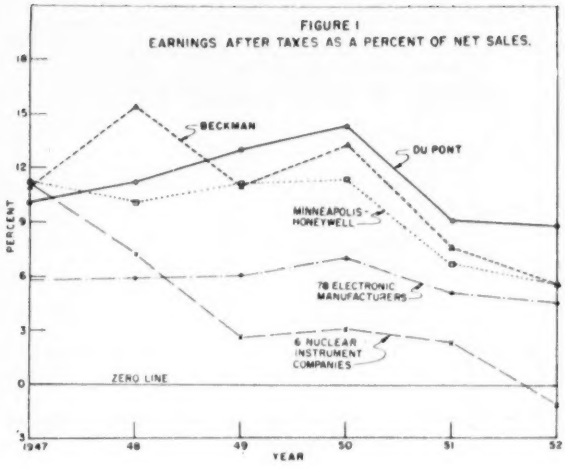
*President of Radiation Counter Laboratories, Inc.; chairman of the Sub-Committee on Standardization of Nuclear Laboratory Instruments of the RTMA; and editor "Nuclear Reactors for Research & Industry," Instruments Publishing Co., 845 Ridge Ave., Pittsburgh, Pennsylvania.

THE NUCLEAR-INSTRUMENT INDUSTRY

Data is included on the six companies in the field which, in 1952, had a total business of more than a quarter of a million dollars; which had sales amounting to more than sixty percent in the nuclear instrument field; and which had readily available records. These six companies are tabulated in Table 1.

A few large companies have produced a high dollar-volume of nuclear instrument business. Their income in this special field is an almost negligible portion of their total sales and is, moreover, almost entirely defense business. Hence their performance is not truly representative of the industry. Although a host of smaller companies have contributed to the growth-impetus of the nuclear-instrument business, the six companies herein studied are believed to reflect truly the trends and accomplishments of the industry. Moreover, it appears that the six companies did approximately fifty percent of the business in the nuclear-instrument industry.

These six larger companies in the field are becoming increasingly general (even to the point of including non-nucleonic production), and as a result will in the future scarcely reflect the industry with accuracy. Hence it is believed the present study represents the industry today.



Interestingly enough, the nuclear-instrument business is dominated by small companies organized after World War II, with the single exception of one which was chartered in 1931. Here, then, is a new industry which already appears to be following the growth pattern of all new industrial activity—phase one, birth; phase two, development of an excessive number of companies; phase three, emergence of dominant companies through competition and mergers; phase four, maturity. The nuclear-instrument industry is now somewhere between stages two and three. Following are thumb-nail sketches of the activity of those companies included in this survey.

Atomic Instrument Company, Cambridge, Massachusetts, formed in 1946, originally started making electronic instruments for the nuclear-instrument industry. It has now broadened its line, venturing into the sensing-element field, but has specialized in electronic instruments, particularly those intended for the laboratory.

Nuclear Instrument and Chemical Company, Chicago, Illinois, started in 1946, had its genesis as a manufactory of scaling circuits. Since then, besides expanding its scaling circuit work, the company has also strongly entered the portable instrument field, the radiochemical field, and has developed flow counters and scintillation counters.

Radiation Counter Laboratories, Inc., Skokie (Chicago), Illinois, organized in 1946, originally made radiation counter tubes and now manufactures detecting elements of a wide variety. It has broadened its scope to include laboratory equipment, accessories, and special electronic circuits, particularly nuclear reactor control equipment, and (through an associated company, Wakefield Industries, Inc.,) scientific glassware and special chemicals.

Radioactive Products, Inc., Detroit, Michigan, chartered in 1948, is primarily an electronic manufactory that originally specialized in contract work. More recently it has broadened its electronics activity to include special instrumentation related to the oil-well industry.

Tracerlab, Inc., Cambridge, Massachusetts, set up in 1946, was originally a diversified company with sensing elements, electronic circuits, portable instruments, and radiochemicals. Its purchase of Keleket X-Ray Corporation in 1951 has led into a broad X-ray-equipment market.

Victoreen Instrument Company started in 1931 as a group of X-ray dosimetry manufacturers. Until 1946 they were the only fabricators of nuclear instruments. The manufacturing of ion chambers led them into the production of special components such as special resistors, unique electronic tubes, and more recently, radiation counter tubes. The purchase not long ago of another company, Pioneer Electronic Corporation, has broadened their output to include fluorescent lamp starters and other non-nuclear equipment.

Ownership

Of the six companies included in this study, five (Table 1) have relatively widely dispersed ownership; only one, Radiation Counter Laboratories, Inc., is closely held. Radioactive Products, Inc., was the first company in the industry to have public issues of stock, selling 125,000 shares in 1948. This company has subsequently sold 212,500 shares. Tracerlab, Inc., sold $300,000 of preferred stock in 1948; $1,300,000 (104,000 shares) of common stock in 1949; $2,289,000 (175,000 shares of common) in 1951. Atomic Instrument Company marketed 33,000 shares in 1949, and 47,700 shares in 1951 for a public participation of about one quarter of a million dollars. Nuclear Instrument and Chemical Company sold 74,500 shares at $4.00 per share in 1952. Victoreen Instrument Company marketed 221,000 shares in 1951 and is believed to be the most widely held company. Only Radiation Counter Laboratories, Inc., has not marketed stock.

Sources of Industry Management

The six companies which make up this study obtained their management from war-time research laboratories, with the single exception of the Victoreen Company. The original management of the Victoreen Company entered the nuclear-instrumentation field first by way of the radio business and then of X-ray dosimetry. The managements of Nuclear Instrument and Chemical Company and of Radiation Counter Laboratories, Inc., were spawned at the war-time atomic-bomb project of the Metallurgical Laboratory of the University of Chicago. The managements of Atomic Instrument Company, Tracerlab, Inc., and Radioactive Products, Inc., have as their background the Massachusetts Institute of Technology.

With leadership for five of the six companies originating in scientific research laboratories, one might assume that their managements would have an immaturity, a naiveté, yes, and a boldness not characteristic of longer established and more profitable companies; this assumption is correct.

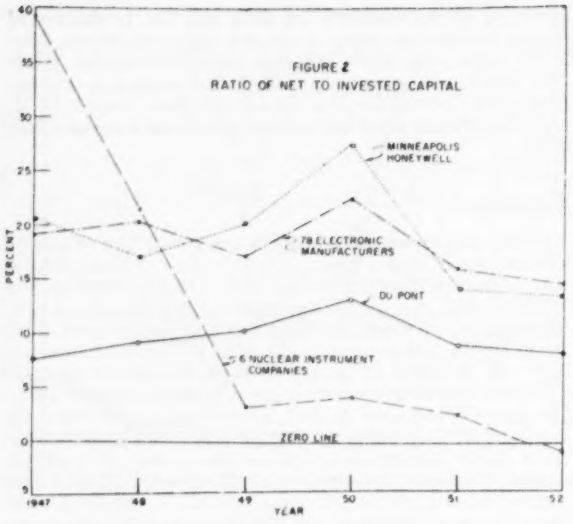
Earnings of the Industry

In discussing the earnings of an industry, one might consider earnings on the basis of net worth, of earnings per share, of earnings either before or after taxes, or of earnings as a percent of sales after taxes. This study is based both on earnings as a percent of net worth and as a percent of sales, because, while an investment banker might appreciate earnings as a percent of net worth, it is believed that the average reader of this article, a scientist or engineer, most clearly understands earnings as a percent of net sales—in other words, for every one hundred dollars of sales, what is left, after all expenses have been met, for the growth of the company?

Historically, instrumentation has been a close-margin business[1]. The selling price of an instrument has typically been two to five times the labor cost, which, in general, has been the largest single expense.

Although the boldness of the pioneer entrepreneurs in the nuclear-instrument industry has succeeded in chartering many companies in this field, their management has failed to bring significant over-all profits for their efforts. In fact, if the present profit on sales-after-taxes or even as a percent of invested capital is compared with the consistent performance of well-known companies in other fields from 1946 to 1952, one wonders what attracts investors to the nuclear-instrument industry.

[1] *The Instrument Market*, Instruments Publishing Company, June, 1953.



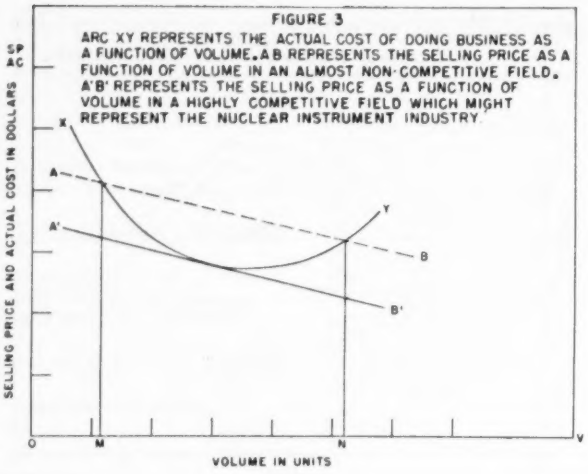


FIGURE 3
ARC XY REPRESENTS THE ACTUAL COST OF DOING BUSINESS AS A FUNCTION OF VOLUME. AB REPRESENTS THE SELLING PRICE AS A FUNCTION OF VOLUME IN AN ALMOST NON-COMPETITIVE FIELD. A'B' REPRESENTS THE SELLING PRICE AS A FUNCTION OF VOLUME IN A HIGHLY COMPETITIVE FIELD WHICH MIGHT REPRESENT THE NUCLEAR INSTRUMENT INDUSTRY.
SELLING PRICE AND ACTUAL COST IN DOLLARS
SP
AC
X
A
A'
Y
B
B'
O
M
N
V
VOLUME IN UNITS

To supply an economic standard or comparison, the author has selected three non-nucleonic firms, each of which is well known and is commonly accepted as a leader in its special field. Each also is either on the fringe of the nuclear-instrument industry or is a user of the industry's wares. Some arresting facts are brought out by a comparison of these three major companies in the non-nucleonic field with the six nucleonic companies under study (Fig. 1).

The chemical giant, E. I. du Pont de Nemours and Company, Inc. (designated by Jackson Martindell[2] as the best-managed company in the world and operating as a prime contractor for the Atomic Energy Commission) has a net income as a percent of sales between nine and fifteen percent, and a net on invested capital of five to fifteen percent. The Beckman Instrument Company, Inc., which manufactures scientific instruments in a comparable but principally non-nucleonic field, has a net on sales which varies between six and fifteen percent. The Minneapolis-Honeywell Company, a diversified instrument company, earns from five to thirteen percent on sales. The highly satisfactory earnings of these three companies contrast sharply with those of the six nuclear-instruments companies during a comparable period—earnings that oscillate slightly above and (at times) below the profit-and-loss line. In fact, during the six years of this study, these six nucleonic manufacturing companies had net sales of $25,477,660 and a net profit of $749,920; in other words, a net on sales averaging three percent. The reasons for this abysmal earning record in the nucleonic industry will be discussed.

Even if one considers the ratio of earnings to invested capital of the nuclear-instrument industry (Fig. 2), the performance is still inadequate. Surely a new industry producing necessary items should start off with an exceedingly high ratio of net to capital. One would normally expect a decline of this ratio as the industry becomes more competitive and mature. This decline comes normally because of investment in more efficient and more costly machines for making a product (which fact usually circumscribes the basement-shop operator) and because the economic need is satisfied to a greater degree than was true at the onset. Fig. 2 illustrates the ratio of net to invested capital for the duPont Company, the Minneapolis-Honeywell Company, seventy-eight electronic companies[1] and the six companies cited of the nuclear-instrument industry.

[1]Source: The National City Bank of New York.

[2]Scientific Appraisal of Management, Jackson Martindell, Harper Bros., 1949.

Reasons for Low Profits

There are five major reasons for the low profit figure:

1. Inexperienced management.

2. Low capital entrance requirements coupled with bidding procedure.

4. Dominance of a single buyer.

5. Unfavorable tax position.

Inexperienced Management

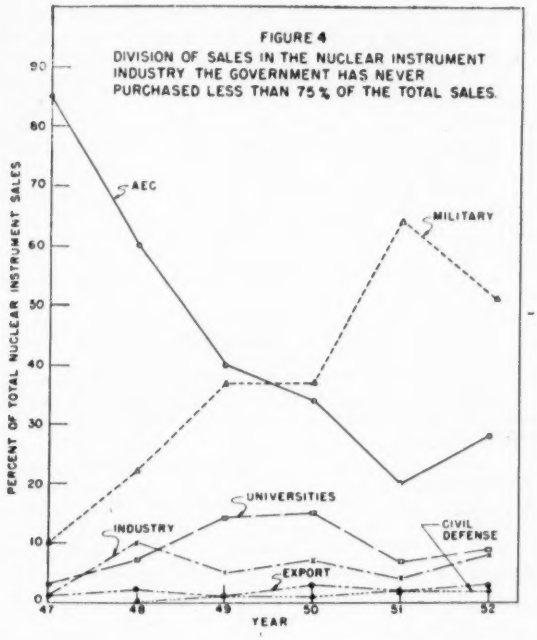
Early management, although scientifically efficient, was not sufficiently aware of the five components of the costs of doing business: (1) material cost, (2) labor, (3) manufacturing burden, (4) general and administrative burden, and (5) profit on investment. As a result, particularly in the electronic end of the instrumentation field, a comparatively insufficient price was placed on the finest equipment ever offered for sale. It requires perspicacity in management to realize that there may be inadequate earnings even though business increases rapidly. Now, through lessons learned by experience and through additions of business representatives to company management teams, the selling prices of nuclear instruments have increased.

The poor earning record in the year 1952 for the industry, *while volume was rising spectacularly*, is believed due to the failure of adequate management control. This poor control is reflected in abnormally low inventory turnover, one company reporting an inventory turnover of only one and one-sixth times per year. It would appear that earnings, both real and as a percent of sales, should increase—if stabilization and adequate controls can be achieved.

Low Capital Requirements

In a new economic field where capital needs are low, the profit margins on sales will also be low. Conversely, where capital requirements are high, profit margins on sales will be high. It is for this reason that the electronic industry[1] had profits on sales for 1952, a bonanza year for electronics, averaging 4.6 percent, and a yield on capital of 14.8 percent, while chemical companies, which have a large investment per employee, had a ratio of net to sales of 7.7 percent and a yield on net assets of 13.7 percent. These outcomes follow from the fact that if the ratio of capital to labor cost is low, the ratio of sales to capital may be high. This means that for a given rate of return on capital the rate of return on sales must be lower than otherwise. Such a principle is buttressed by the fact that low capital requirements make entering an industry attractive to small investors. The

[1]Source: The National City Bank of New York.



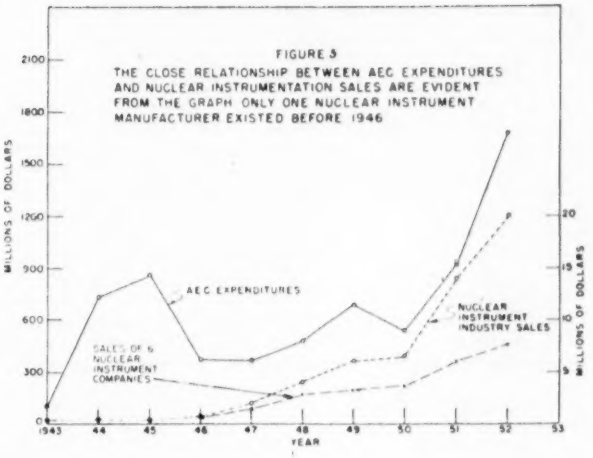


FIGURE 5
THE CLOSE RELATIONSHIP BETWEEN AEC EXPENDITURES AND NUCLEAR INSTRUMENTATION SALES ARE EVIDENT FROM THE GRAPH. ONLY ONE NUCLEAR INSTRUMENT MANUFACTURER EXISTED BEFORE 1946
MILLIONS OF DOLLARS
AEC EXPENDITURES
NUCLEAR INSTRUMENT INDUSTRY SALES
SALES OF 6 NUCLEAR INSTRUMENT COMPANIES
YEAR

resulting ease of entry forces market prices for the products of the industry to approach the costs of production and in this way lowers the return on capital investment. This economic principle is illustrated in Figs. 1 and 2; note how the percentage returns for the duPont Company and the seventy-eight electronic manufacturers shift positions for net on sales and net on investment.

Nearly any skilled technician can build a satisfactory radiation-detection instrument; in his basement he may build ten to twenty-five instruments. But such an entrepreneur cannot supply the capital to make a complex polymer such as Nylon. While the capital investment per employee[1] of the duPont Company in 1952 was $19,300, and the output per employee per month was $1510.00, similar figures for the nuclear-instrument industry would be perhaps a tenth and two-thirds of the respective duPont figures. Therefore, on government bids—and these constitute a major part of the nuclear-industry's activity—small shops can and do obtain small-run contracts which the larger nucleonic companies, with higher overhead resulting from original development work, would like to have. This combination of bidding procedure and of low capital needs is particularly damaging to the growth of the nuclear-instrument industry and its ability to become self-sufficient in research.

As time goes on these low capital requirements will rise. Through an advanced sales organization and a better product offered by the major nucleonic companies, basement-shop competition will lessen and the industry's profits rise.

Excessive Number of Companies

There are approximately eighty nuclear-instrument companies competing for some ten million dollars of non-military business annually. Under such conditions, no company can reach sufficient production on any item to minimize costs. This principle, so important in the nuclear-instrument industry, is illustrated by Fig. 3. Suppose we plot volume of business horizontally. On the vertical, we can plot selling price (SP) and actual cost (AC). For a plant of given size there are certain fixed costs; consequently, if volume is increased, unit costs go down to a minimum; then, as the point of maximum efficiency is passed, costs again rise. A plot of this function yields arc XY.

As a price of a product is reduced, the volume which may be sold increases. Such a function would be the dotted line AB of negative slope. When there is insufficient competition, an industry may operate anywhere between points M and N and be profitable.

If, however, there is a large number of competing companies, then economic pressure depresses line AB to A'B', which is tangent with arc XY. Under such conditions the industry is profitable at but one point of volume. If a company in the industry lowers prices to increase volume, it loses money; if it raises prices to increase profit, its volume reduces and it loses money again. Under such conditions, only the company with superior management can have a satisfactory earning record; this one company might operate along line AB. An analysis of profit-and-loss statements of several companies indicates that these double horns of a dilemma actually have been faced by company management; in several cases the analysis of successive profit-and-loss statements indicates that while annual business was increased, profits were reduced.

Dominance of a Single Buyer

Monopsony, a single buyer, (the U. S. Government) is prevalent in the nuclear-instrument industry. Under monopsonistic conditions, price may be set by the purchaser. This has occurred in the nuclear-instrument industry. The government, acting through prime contractors who customarily earn six to thirteen percent on sales, has withdrawn from the market rather than accept the low bid from an industry which cannot be sure it will be profitable. The federal government, either through the AEC or the military, has never purchased less than 75 percent of the total annual sales in this industry. This dominance is evident from Fig. 4.

Although Fig. 4 indicates a reduction beginning in 1950, in purchase activity by universities and industry, the opposite is true. This anomaly appears because of the great increase in AEC and military procurement associated with the military preparedness program beginning in 1950. Fig. 5 illustrates how the sales of the nuclear-instrument industry has paralleled the expenditures of the AEC. This figure also illustrates—by the divergence, beginning in 1950, of the lines representing nuclear-instrument industry sales and sales of the six companies—the importance of military contracts placed with the giant electronic companies. Moreover, the data representing nuclear-instrument industry sales are based on estimates provided by the AEC, whereas the other two lines are based on factual reports.

Almost without exception, when a single buyer is dominant the resultant net is small. Witness the fact that the U. S. aircraft industry, with an average net of about two percent,

[1]Annual Report 1952, E. I. duPont de Nemours and Company.

is having difficulty financing[1] the development of a jet-type airliner to match the British "Comet." In addition, for the past twenty years, the word "profit" has had in government and business circles a nefarious connotation. To rely on stigmatization to control our economy is to set aside the laws of supply and demand. The true liberal economist would agree that no business operating under competitive conditions can have an excessive profit margin; profit is but an economic sign post indicating where the economy requires investment capital. Likewise, a low profit margin is an indication that economic wants are adequately met.

As the nuclear-instrument industry matures, and particularly if Congress revises the McMahon Act (which controls fissionable material) so that private industry may satisfactorily enter the nuclear-energy field, monopsony will be less prevalent. Profits of the nuclear-instrument industry then should rise, both in dollars and as a percent of sales.

Unfavorable Tax Position

The corporation tax severely limits the earnings of all companies today. Especially does the so-called Excess Profits Tax greatly burden all growth company.

The Federal corporation income tax is now (1953) 30 percent on all earnings* less than $25,000, 52 percent on all earnings above $25,000, and an additional 30 percent (Excess Profits Tax) on all earnings above the best earnings in the base period 1946-1949. Therefore, it is relatively easy for a growing company to be taxed 70 percent of its net earnings while a huge and non-expanding company may bear a tax of only 52 percent of its net earnings. It is from this basic inequity that most opposition has arisen against the extension of the so-called Excess Profits Tax.

". . . eventually industry, as with other capital goods, will be the greatest buyer of radioisotope measuring and handling equipment."

It is unfortunate but it is a fact that most companies in the nuclear-instrument industry are either too old to receive favorable consideration as a new company, or are too new to have established a satisfactory earning base. For example, one of the six nuclear-instrument companies considered in this article will pay an excess profits tax in dollars nearly equal to that of the well-known tobacco house P. Lorillard Company, which had in 1952 a net income, after all taxes had been paid, of $5,700,942.00; yet the nuclear company's earnings are but a fraction of that. The Excess Profits Tax, therefore, which is expected to provide $800,000,000 revenue for the U. S. Treasury in the second half of 1953, is extremely inequitable to any small-growth industry.

Customers of the Industry

The AEC has announced the list of customers of the nuclear-instrument industry. The division of sales is illustrated in Fig. 4. The federal government has never purchased less than 75 percent of the total sales of this industry.

Before 1946, and during the army operation of what was until 1946 known as the Manhattan Project, the great bulk of nuclear instruments was manufactured on the various Project sites themselves. In 1946, with several suppliers available, the AEC, which was then the principal user, accelerated the purchasing of nuclear instruments from free enterprise. This policy, continued as the industry has become more mature, is now dominant. There are, however, still at least two AEC sites which manufacture nuclear equipment in a quantity which any one of the companies cited herein would be able and willing to assume. Top-level policy probably will bring these operations more into line with the American way of life as time goes on.

Several company managers in the nuclear-instrument industry feel that while the AEC has been thoughtful in directing income producing business toward their industry, the Defense Department has too willingly directed sizable contracts to large non-nucleonic producers who were not particularly interested in sustaining the nuclear-instrument industry, but only in handling the contracts for the volume of business involved.

Universities and medical laboratories have, to this time, been the largest non-Governmental steady customers. It may be surmised, however, that *eventually industry, as with other capital goods, will be the greatest buyer of radioisotope measuring and handling equipment.* Export business and providing prospectors with radiation survey meters has been a small but helpful assist to this industry. Civil-defense activity, starting in 1949, will follow the rise and fall of military purchases.

Trends in the Industry

The nuclear-instrument industry has seen five major trends over the past six years. The first trend is annual increase of sales coupled with constant lowering of net to invested capital.

The second trend is an increase in the variety of products produced by each of the major producers. The broadening of product base has promoted competition. In addition, there has been, significantly, an expansion of the nucleonic companies into non-nucleonic fields. These facts indicate kinetic and aggressive management.

The third trend is toward improvement in the quality of instrumentation.

A fourth trend has been the prevalence of common stock sales. Stock sales have been engendered by impairment of working capital, accelerated by increased business with either losses or, at best, small net.

A fifth trend has been the emergence of a sales organization in each of the companies. At present, however, each of the six companies primarily sells directly to the customer. The concept of the distributor has not entered, and until the price mark-ups are increased, the distributor cannot emerge.

In conclusion, it may be said that the nuclear-instrument industry has existed in a field dominated by public expenditures. It has not prospered unduly. Net income both as a percent of sales and as a percent of invested capital has been smaller than one might expect for a new industry. One may state further that, as long as Government remains a major buyer, and as long as capital requirements for entering the industry are small, the net on sales and on invested capital will be modest. The nuclear-instrument industry is believed, however, to be a growth industry. It should, as time goes on, receive a reasonable return on invested capital.

As was pointed out earlier, the period is rapidly approaching a close when this industry can uniquely and specifically be examined as it can at this time. It is hoped that the nuclear-instrument industry can be built to a greater degree on re-invested earnings rather than on contributed capital.

Acknowledgments

The author would like to thank the following contributors, who, while in no way responsible for the conclusions drawn, have contributed to the paper's preparation: Philippe G. Jacques of Public Relations of the AEC; the United States Treasury Department; Glenn R. Miller, partner, Cruttenden & Company; Professor Robert H. Strotz, Department of Economics, Northwestern University; W. C. Lang, Controller, E. I. du Pont de Nemours & Company; W. J. Salzer, Treasurer, Beckman Instruments, Inc.; J. H. Binger, vice president, Minneapolis-Honeywell Regulator Company; L. W. Cronkhite, President, Atomic Instruments Company; James A. Schoke, President, Nuclear Instrument & Chemical Company; Robert F. Carlson, Controller, Radiation Counter Laboratories, Inc.; Homer S. Myer, President, Radioactive Products, Inc.; and Cyrus W. Haller, President, Victoreen Instrument Company.

[1] *American Aviation*, July 6, 1953, Page. 14.

*Earnings are net income after expenses—Ed.

Probe Recovery Factor

By J. D. HUMPHREYS
Northrop Aircraft, Inc.

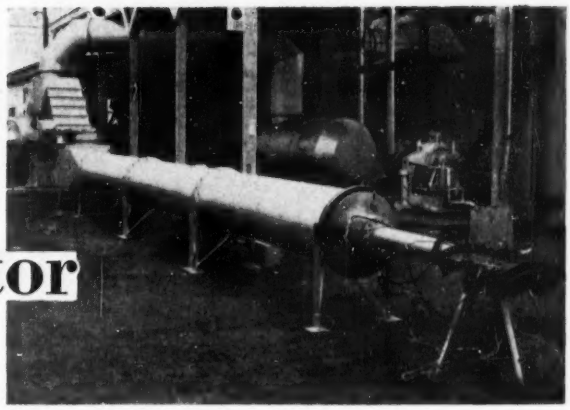


Fig. 1. Airflow equipment for calibration of probe recovery factor.

TEMPERATURE of a moving fluid is difficult to measure accurately. Errors are caused by partial stopping of the fluid in the vicinity of the pickup probe, which results in a measured temperature increase owing to partial conversion of the fluid kinetic energy to heat. The fraction of the fluid kinetic temperature which is registered by the probe is called the *recovery factor*. For an airstream, the fractional kinetic temperature indicated in degrees by a temperature probe is $KV^2/2gJC_p$, where V is airstream velocity, g is acceleration due to gravity, J is mechanical equivalent of heat, C is fluid specific heat at constant pressure, and K is the probe recovery factor. K equals indicated kinetic temperature divided by actual kinetic temperature.

If a test probe having an unknown recovery factor is placed in an airstream with a reference probe having a *known but different* recovery factor, and both probes are exposed to the same airstream velocity, differences in indicated temperatures will be observed. From these temperature differences the test-probe recovery-factors can be calculated. This assumes negligible heat transfer due to radiation, conduction, and moisture condensation or evaporation; care should be taken in setting up the test equipment to minimize these effects. Under such conditions the temperature indicated by the *reference probe* in degrees Rankine is

$$T_m = T_s + KV^2/1.22 \times 10^4$$

where T_s is absolute airstream static temperature in deg. Rankine.

Temperature indicated by the test probe is

$$T_m' = T_s + K'V^2/1.22 \times 10^4$$

where K′ is the test-probe recovery factor.

Solving for K′:

$$K' = K + (1.22)\ (10^4)\ (T_m' - T_m)/V^2$$

Thus the test probe recovery factor can be calculated if V, T_m, and T_m' are known. As the value of $(T_m'-T_m)$ is small, extreme care should be used in the measurement of T_m' and T_m.

Tests were run using a 30,000-cfm. Buffalo blower and calibrated ducting (Fig. 1). Before installing the probes a velocity survey of the nozzle exhaust was made at various airflow settings of the equipment to determine positions in the cross sectional area with equal airstream velocities.

The three probe designs tested (Fig. 2) had iron-constantan thermocouples as sensing elements. Referring to the lower right corner of Fig. 1, the shielded test probe and the reference probe can be seen installed in the nozzle exhaust at positions of equal velocity. A Pratt & Whitney half-shielded cylindrical probe of known recovery-factor was used as the reference temperature probe. It was connected to the recording equipment and the test probes to give the electrical equivalent of $(T_m'-T_m)$ directly. The high-sensitivity elements of the recording system consisted of Leeds & Northrop "Model K-2" precision potentiometer and "Type R" galvanometer. The test results are shown in Fig. 3, which gives curves of the variation of recovery factor with velocity for the three probe designs.

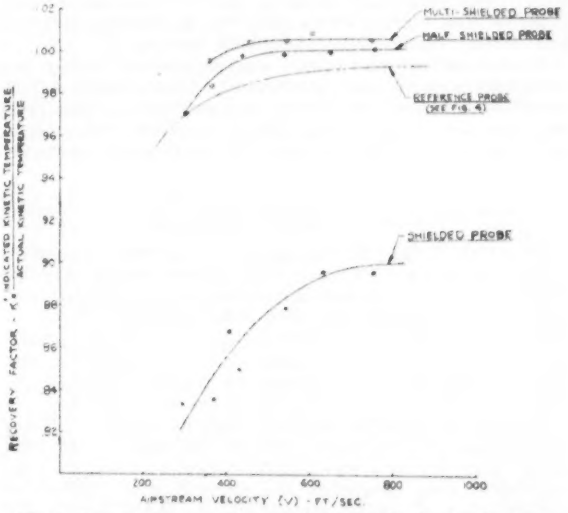


Fig. 3. Recovery factor vs. stream velocity for the three probe types.

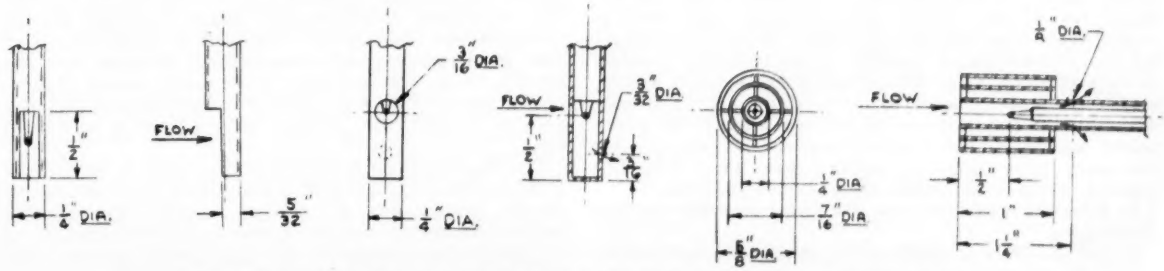


Fig. 2. Probes tested. Left, half-shielded probe; center, shielded probe; right, multi-shielded probe.

Nuclear Reactors for Industry and Research

Instruments for Experiments

Basic nuclear instruments used in experimental work are (1) the A-1 Linear Amplifier, (2) scalers, (3) counting rate meters, and (4) scintillation spectrometers. This sixth installment also presents instrument maintenance and reliability considerations.

by CLINTON G. GOSS
Radiation Counter Laboratories, Inc.

ALL NUCLEAR INSTRUMENTS can be used for experimental purposes. When the kinetics of a reactor are under investigation, all reactor-control instruments described previously become experimental units. Similarly, instruments used for personnel protection also can be used for experimental purposes. These include linear amplifiers, scalers, rate meters, differential pulse-height analyzers, various special power supplies, Geiger tubes, filled and gas-flow proportional counters, BF_3 counters, and the various scintillation materials such as anthracene (for Kurie plots from beta particles and for fast coincidence experiments), sodium iodine (Tl) for gamma-ray spectra, and lithium iodide (S_n) for neutron spectra.

Reactor-control instruments and radiological safety instruments already have been discussed previously. A few basic instruments, used widely in experimental work, are discussed here—(1) the A-1 Linear Amplifier, (2) scalers, (3) counting rate meters, and (4) scintillation spectrometers.

The A-1 Linear Amplifier

The Oak Ridge (Bell-Jordan) A-1 Linear Amplifier, (Fig. 6-1) is an instrument that is used widely in pulse amplification work. It uses the technique of successive integration, amplification, and then differentiation in order to effectively increase the signal-to-noise ratio of the amplifier. The pulses are first integrated, then amplified, and then differentiated to reproduce the original signal shape. Fig. 6-1 shows a block diagram of the A-1 amplifier.

Almost all radiation-detection devices produce current pulses from high-impedance sources. The input circuit of a linear amplifier is a small shunt capacitance and a large resistance that integrates the current pulse. After an amplification of approximately twenty times in the A-1 (limited by pile-up effects in the preamplifier), the integrated signal is differentiated to reproduce the original signal (or—if the original signal duration was short—a signal whose amplitude is proportional to the original signal but whose duration depends on the transient response of the amplifier). After differentiation, the signal is attenuated to the proper level to enter the main amplifier section. After further amplification the pulses are fed to the pulse-height selector (P.H.S.) which produces an output pulse for every pulse larger in voltage than the P.H.S. dial reading, which is adjustable from zero to 100 volts.

In noise characteristics, the A-1 linear amplifier has two advantages:

1. The integration, amplification, and differentiation techniques successively reduce all noise associated with the preamplifier by a factor proportional to frequency; i.e., low-frequency noise is highly attenuated.

2. Three bandwidths (or upper cutoff frequencies) are available so that the noise characteristic of the amplifier may be reduced by lowering the frequency pass-band and producing longer output voltage pulses. The lower bandwidths are useful also with ionization chambers that have long collection times and with scintillation phosphors that have long decay times.

For better operation with scintillation spectrometers, several changes have been made in the A-1 amplifier—the external output voltage pulse is controlled by a feedback loop, the wide-bandwidth differentiator has been changed to a delay-line pulse shaper, and the dynamic range of the preamplifier has been improved. The amplifier with these changes is known as the A-1C amplifier.

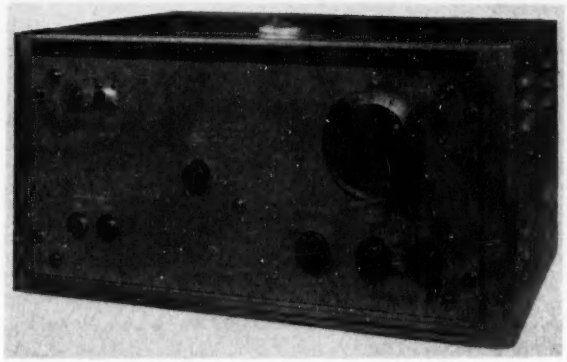
Linear amplifiers are used widely with fission chambers, BF_3 chambers, scintillation counters and spectrometers, and miscellaneous ionization chambers. Their chief advantages are simplicity, reliability, and utility as general-purpose, low-noise instruments. Their chief disadvantage is poor overload characteristic, which must be carefully considered in some experiments. To date, no overload-resistant amplifier has appeared that seems destined to replace this class of amplifier for general use. An overload-resistant version of the A-1 linear amplifier is available, but its use is recommended only for experiments where it must be used.

Scalers, Binary versus Decade

Four-tube capacitor-coupled decade scalers have been used since before World War II, but to date have not been as satisfactory as the diode-coupled scale-of-two introduced by Higginbotham.

The pressure from instrument users for a low-cost decade scaler is so high that almost every company constructing scalers has included a decade unit at one time or another. The proponents of inexpensive decade units are always optimistic and often confess that their previous units have been unsatisfactory, but announce that they now have the solution to all the problems of four-tube decade scalers. If they succeed they must prove it; unsatisfactory performance of decade units to date has produced a prejudiced field.

The Higginbotham scale-of-two (Fig. 6-2), is constructed with good capacitors, resistors, and tube sockets, and can be checked rapidly, both for present operation and expected failure. All that is necessary is a simple measurement of the grid-cathode voltage of the non-conducting side of the tube. If the conducting side of the tube is in the process of



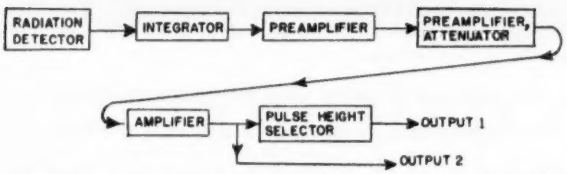
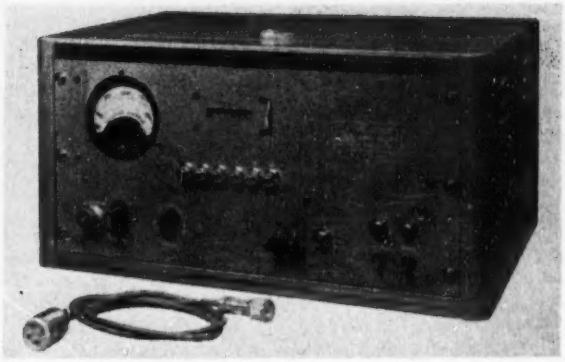


Fig. 6-1. Oak Ridge A-1 Linear Amplifier, widely used with fission chambers, BF_3 neutron counters, scintillation counters, and spectrometers. In block diagram, output 1 goes to scaler; output 2 to differential pulse-height analyzer.



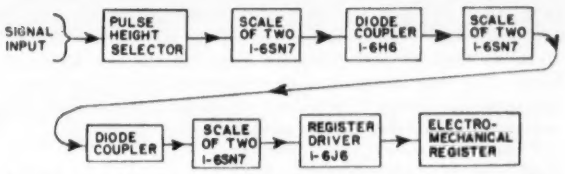


Fig. 6-2. The definitive feature of a Higginbotham Scaler is the diode coupling between binary scaling stages.

failure by loss of emission,* this voltage is lower than normal. Checking the scaling tubes in a tube checker is not only a waste of time but is confusing to the maintenance man. He may replace good tubes with new ones whose life may be short. A tube that has operated satisfactorily for a thousand hours in a given instrument has a greater probability of surviving an additional thousand hours of operation than has a new tube of operating properly during the first thousand hours of its life. Further, if a scaler (or any other instrument) is to be used on a following day, it should be left on and counting, either on background, amplifier noise, or a signal generator. This is because the stresses endured by a vacuum-tube filament during frequent instrument turn-ons cause appreciable reduction in tube life.

Counting Rate Meters

Counting rate meters have not had wide use because (1) they have a lower dynamic range than a scaler has, (2) stability and linearity failures do not announce themselves as does a misbehaving scaling stage, and (3) experimenters are reluctant to wait long periods for the storage circuit of the counting rate meter to stabilize if, at the same time, they are discarding a large amount of the information they are collecting. Although rate meters are useful as special-purpose units or auxiliary devices, they are not replacements for scalers for general use.

For short-half-life activities produced in the reactor, the Logarithmic Counting Rate Meter is particularly useful because the decay of an activity having a single period produces a straight line on a uniformly moving recorder chart. The logarithmic units, however, have certain characteristics that must be considered carefully before experiments are performed with them.

The Scintillation Spectrometer

Instruments are usually employed in groups in the performance of an experiment; hence an experimental arrangement for scintillation spectrometry will be described. (The Geiger tube has not outlived its usefulness; however, certain basic physical measurements require the unique characteristics of the scintillation spectrometer or other energy-proportional devices.)

At the Oak Ridge National Laboratory the primary choices of phosphors for detecting elements have been anthracene for beta particles, and sodium iodide for gamma radiation. The flashes of light produced by the bombardment of these phosphors are detected by photomultiplier tubes of special design usually the RCA "Type 5819" or the DuMont "Type 692." The photomultiplier must have a precisely regulated high-voltage supply because a voltage change of one percent produces a change of gain of the photomultiplier of several percent. Fig. 6-3 is a block diagram of a scintillation spectrometer.

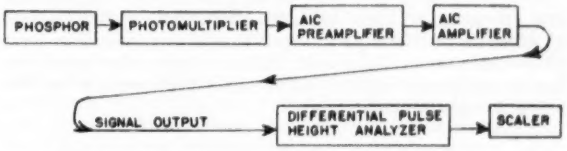


Fig. 6-3. Block diagram of a scintillation spectrometer.

The photomultiplier output is fed through the A-1C amplifier to produce signals of a magnitude suitable for analyzing. Following the amplifier is a differential pulse-height selector that determines the number of pulses per second that occur between two and three volts output, three and four, four and five, etc., up to 89-90 volts output from the A-1C amplifier. As all the circuitry used is linear, a plot of output counting-rate versus pulse height represents the response of the phosphor to the radiation being studied. In the event that scalers are to be used, it is generally preferable to use predetermined-count techniques; these provide data with a constant statistical error. Some experimenters working on special problems make use of count-rate meters and recorders.

General Aspects

Three important general aspects of instruments for experiments are (1) experimental arrangements, (2) power supply, and (3) the important subject of instrument reliability.

* Failure by loss of emission is the most insidious type of failure since it may permit the scaler to scale-through (produce two output pulses for two input pulses) intermittently. The most desirable type of failure is for the scaler to refuse completely to count. Then no incorrect data are recorded.

Experimental Arrangements

Space requirements for experiments increase rapidly. Careful original design will provide additional area for expansion. For example, the reactor building can be located in an open space so that adjacent laboratories may be constructed at a later date. These laboratories may be served by pneumatic tubes that enter the reactor, thus permitting the performance of short-half-life studies away from the reactor proper.

A major feature of a reactor is its copious supply of moderate- to slow-energy neutrons. Hence, all installations which do not use neutrons should be placed away from the reactor so that later experiments may be accommodated without major disruptions.

The control room should be near the reactor because of instrumentation problems, but its configuration should be such that it occupies minimum space adjacent to the reactor. Some vacant space should be left in the control room so that critical inreactor experiments can be monitored. The use of mutilple experimental levels (or floors) increases the value of a reactor in direct proportion to the increased utilization of the neutrons.

Provisions should be made so that samples of extremely high activity can be removed from the reactor and placed in a carrier for transport in such a manner as to eliminate needless exposure of personnel in handling operations. Some experiments will require neutron beams of high intensity. Shielding should be provided to attenuate completely the neutron beam and to prevent the scattered neutrons and other radiations from raising the background for low-level experiments being performed nearby.

The use of a false floor (drained) will permit flexibility of experimental arrangements without having cables draped across the floor. If a false floor cannot be justified, a network of trenches with cover plates (that must be held to remain open) are useful.

Low-level signal leads should be segregated from furnace and other power leads that are controlled by relays. Use of gaseous rectifiers and power thyratrons should be permitted in or near the reactor building only after each unit has been shielded and tested for its interference with low-signal-level equipment.

Power Requirements

Electronic instruments associated with a nuclear reactor should be supplied with large currents of 115 volts a.c. (plus or minus five volts), free from high-frequency electrical interference. The restriction on the variation of the supply voltage is to prolong vacuum-tube life; tube life is a sensitive function of filament voltage. D-c. amplifiers such as Log n Amplifiers and Magnet Amplifiers require precisely regulated filament supplies.

For reliability, magnetic regulators of the low-harmonic-distortion type manufactured by Sola are recommended. Each instrument should be supplied from its own Sola regulator because of the high series impedance of these units when overloaded. On start-up, an instrument normally draws several times the operating current and may produce an appreciable voltage drop in the regulated supply. Large units intended to supply a number of instruments are particularly tricky unless all the outlets are controlled by one experimenter who understands the characteristics of the Solas, and who monitors the total load current on a meter.

Power lines supplying not only the instruments but also the lighting and utility circuits in the proximity of low-signal-level experiments should have a minimum of high-frequency electrical interference from sources such as r-f. power supplies in scalers, fluorescent lights, relays, brush-type motors, induction heaters, streetcars, neon signs, nearby high-powered radio transmitters, and nearby transmission lines of more than 4000 volts. It is desirable to operate linear amplifiers from Sola low-harmonic-distortion regulators in order to reduce the interference introduced into the amplifier and to improve the stability of the pulse-height selector. However, the greatest trouble usually encountered with high-gain linear amplifiers is caused by multiple ground connections. There should not be more than one metallic ground connection in an entire experimental assembly, and that one should be at the linear amplifier's preamplifier.

Instrument Reliability, or How to Produce the Maximum Output of Correct Experimental Data with Minimum Effort and Frustration.

The technique is to use good instruments correctly.

Anyone can say: "For reliable instruments use good components in well-designed circuits." The difficulties begin when the words reliable, good, and well-designed are to be defined and put into practice. The economic squeeze contributes much to the deficiencies of radiation-detection equipment. Good components cost more money than less sound ones. To produce an instrument priced competitively with other units, a user of better parts must be ingenious and use fewer parts. When this economy is impossible, the price goes up, sales go down, and the squeeze is on. No company is immune to these effects.

At the Oak Ridge National Laboratory, two types of instruments have better-than-average service records. One is the A-1 amplifier, and the other is the Higginbotham-type scaler. Scaler maintenance procedure has been described.

If the A-1 amplifier has been constructed properly, if the wires follow the specified routes, if good solder joints have been made, if the trimmer capacitors are properly adjusted, and if the instrument has worked properly once, it can be serviced largely by measuring voltages to determine which tube needs replacement. A thorough check requires the use of a suitable pulse generator and an oscilloscope, but the preliminary voltage check is most informative.

Many good nuclear-instrumentation techniques have evolved from the Manhattan Project. Unfortunately, some of the manufacturing standards of the competitive radio and television industry seem to be creeping into the nuclear-instrumentation field, leading to more instrument failures. A complete instrument failure is easily detected and remedied, perhaps by the use of a trash can, but an intermittent or partial failure can be an interminable plague.

Most radiation-detection experiments involve too much time and money to justify economizing on instruments. This is doubly true for tracer research. Moreover, the experimental set-ups for fundamental research are increasing in size and complexity. Whereas a few years ago an experimenter used an instrument or two containing a scaler and high-voltage supply, and employed a Geiger tube with absorber foils, he now uses one or two seven-panel relay racks full of equipment for scintillation or proportional spectrometry. As the failure of any portion of the circuits halts the experiment and makes data suspect, reliability is of the greatest importance.

ANNOUNCEMENT

The entire series "Nuclear Reactors for Industry and Research" will be available in book form at the conclusion of the series. The final two subjects to be discussed will be (1) reactor cost studies, by H. J. Gomberg, U. of Michigan, and (2) legal aspects for installation and operation of nuclear reactors, by H. T. Van Mell, Attorney at Law.

FILTER FIELD CONTROL

by JOHN W. HOOD
Sewage Treatment,
Ridgewood, N. J.

Efficiency of trickle-type filter fields for municipal water supplies can be increased by control of the dosing-tank cycle. An electronic-pneumatic control system is described for inexpensively converting existing installations to produce higher volumetric loadings with enhanced oxidative efficiency.

TYPICAL fixed-nozzle filter field is shown in Figs. 1 and 2. The dosing siphons, distribution headers, and nozzle fields are designed for a pre-determined maximum anticipated rate of flow. Within this range, the dosing-tank "cycle" is constantly repeated at a frequency proportional to the rate of inflow. However, when the maximum designed capacity of this pneumatic-hydraulic device is exceeded, the dosing-tank cycle is incomplete and a "flow-through" condition results. In the dosing tank, a water level is then established between the high-water blow-off level and the low-water cut-off level.

This results in a continuous discharge at the filter nozzles, which is a function of the water level in the dosing tank. Thus the entire volumetric loading with its organic content is applied to only a fraction of the available filter media, causing excessive overloading of that portion of the purification mechanism and deteriorated effluent quality.

From a biological oxidation process viewpoint, protracted "rest" periods between dosings, which occur at low inflow periods, may be equally undesirable. This is particularly true in the higher temperature zones, where sun and air circulation combine to dessicate and thus inactivate the zoogleal film at times of infrequent dosing.

Levine[1] showed that in the operation of standard filters, rest periods of more than 2½ minutes reduced the filter efficiency. The reduction in the 5-day B.O.D. (biochemical oxygen demand) improved as the rest period was shortened, but he did not note improvement with a rest period of less than 2½ minutes. Levine's work revealed the presence of unused biological oxidation capacity in the "standard" filter and indicated the benefits to be derived by reduction of rest periods within certain limits.

Some years ago, Plainfield, New Jersey adopted a mechanical means of solving this control problem. The siphon bells were removed; butterfly valves were installed on top of the siphon inlets; and the valve fulcrums were rotated in one direction by drive mechanisms consisting of electric motors and gear reduction units. The non-uniform pattern of rotation was accomplished by cams, cranks, and connecting rods. Efficient distribution was maintained with higher flows, and 95-percent psychoda control was effected.

However, pneumatic control methods were studied in an effort to obviate the necessity for disrupting existing siphon equipment. Examination of Fig. 2 suggests the possible use of air as a throttling or modulating medium by which the depth of water overflowing into the siphons (and hence the volume being delivered to the nozzle field) could be regulated.

Experiments were made to investigate the use of air under the bell for controlling the discharge of water to the field. A pipe was connected to the top of the bell and valves were installed to control the supply of air to the bell and from under the bell (via a branch from the pipe connection) to atmosphere. The experiments were successful and an automatic control system was installed at Ridgewood, New Jersey.

Continued on page 298

Presented at Conference on Instrumentation In Water Sewage and Industrial Waste Treatment, May 14, 1953, Manhattan College, N. Y.

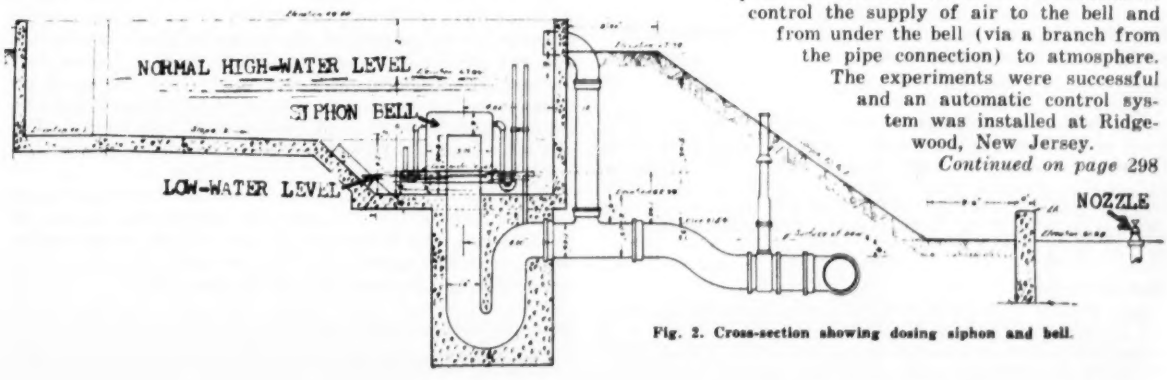


Fig. 2. Cross-section showing dosing siphon and bell.

Left, author checks service record while servicing a VTVM; right, temperature test chamber finds many uses in developmental and service work.

Use and Maintenance of the

A-C VTVM

Knowledge of the techniques for proper use of a VTVM can extend its utility to many impedance and current measurements. Details for servicing each component of the VTVM are presented.

by JAY DOBRIN
Western Scientific Company

VACUUM-TUBE VOLTMETERS have many uses—in addition to their primary function of measuring signal amplitude. These uses include (1) measurement of circuit impedance, (2) measurement of internal impedance of a signal generator, (3) null detection in bridge circuit, (4) voltage amplification, (5) measurement of alternating currents, and (6) measurement of parallel-resonant circuit impedance.

Measurement of Circuit Impedance by 6-db.-drop Method

Connect apparatus as shown in Fig. 1, using an oscillator of *known* internal impedance. With the decade resistor disconnected, adjust the oscillator level to give a convenient reading on the VTVM. Connect the resistance decade and adjust its value (R) until the VTVM reads 6 db., or 50* percent, of its initial value. At this reading the generator impedance (Z_{gi}) plus the unknown impedance (Z_X) equals the circuit impedance R:

$$R = Z_{gi} + Z_X$$

Resistance R must be resistive at the test frequency. The oscillator output must be sinoidal.

Measurement of Generator Impedance

The 6-db.-drop technique can be used also for measurement of the internal impedance (R) of a signal generator. Connect apparatus as shown in Fig. 1 with the resistance decade disconnected. Adjust generator until a convenient reading is obtained on the VTVM. Connect resistance decade and adjust it until the VTVM reads 50 percent of voltage, or 6-db. drop. R then equals Z_X.

Null Detection

The VTVM may be used as a null detector in any a-c. bridge circuit operating at frequencies within the frequency-response range of the VTVM.

Voltage Amplification

The VTVM may be used as a relatively flat voltage amplifier for oscilloscope input magnification, or two VTVM's may be used in cascade for sensitive indications where noise levels are relatively low and absolute accuracy in value of indications is not of importance.

Current Measurement

The VTVM can be used as a multi-range a-c. ammeter with use of precision noninductive shunts, or even with lengths of resistance wire. This is often useful when a thermal-type meter is not available, particularly since rectifier-type multi-test sets do not have a-c. ampere or milliampere ranges.

Connections for use of the VTVM as an ammeter, milliammeter, or microammeter are shown in Fig. 2. For measurement of currents, caution must be used to insure that the voltage drop is actually measured across the precision resistor and not across any portion of the connecting leads, clips or attachments; good contact must be obtained. The test leads from the VTVM, however, need not be of especially high conductance.

The value of R-1 selected in Fig. 2 is determined from formula E/I, where I is full-scale alternating current to be measured, and E is the full-scale VTVM voltage range being used. At higher currents, calculate wattage rating required of this resistor from the formula E^2/R.

Resonant-circuit Impedance

The VTVM can be used to measure anti-resonant (paral-

* Note: 6db. is about 50-percent change in voltage; 3 db. is about 50-percent change in power.—*Ed.*

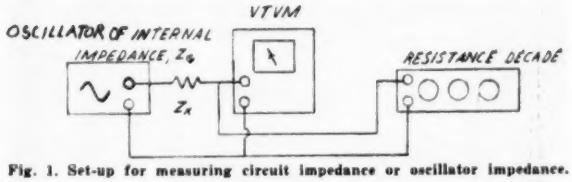


Fig. 1. Set-up for measuring circuit impedance or oscillator impedance.

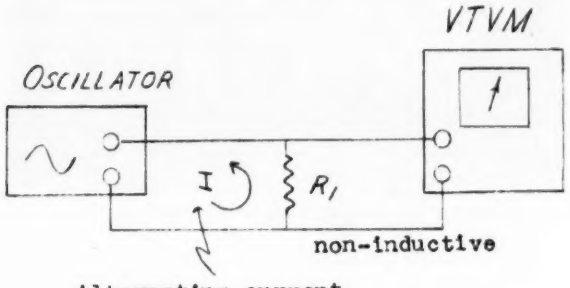


Fig. 2. Set-up for use of VTVM as ammeter or microammeter.

lel-resonant) circuit impedances and, consequently, the approximate Q of tank circuits. A set-up as in Fig. 3 is used. The VTVM must be insulated from ground; a "push-to-test" switch should be included to protect test personnel.

The circuit anti-resonant impedance is determined by comparison of the VTVM indication of the voltage across the 100-ohm resistor against the indication across the tank circuit. The VTVM must have high input resistance and low input capacitance.

VTVM Circuit

A VTVM has *eight* basic segments:

1. *Input attenuator.* The attenuator (Figs. 4 and 5) provides precise decade steps of instrument sensitivity. It is usually composed of several resistors with a suitable selector switch. These resistors influence the step-to-step accuracy of the attenuator. As they are usually connected in a tapped voltage-divider circuit, they are interdependent, and changing one resistor causes readings on all scales above that step to be affected. The attenuator resistors must be checked at a low frequency or else removed from the instrument and checked on a d-c. bridge (Wheatstone). Errors detected at higher test frequencies may be caused not by the attenuator resistors but by compensation error.

2. *Input attenuator compensator* (Figs. 4 and 5). As the attenuator resistors are usually wound of temperature-stable wire, they possess inductance. Even if made of deposited carbon (as in some instruments), the wiring and distributed capacitances of the circuit cause the input circuitry to have a frequency characteristic. The input attenuator compensator permits adjustment of the frequency-response of the entire instrument by means of over-or-under compensation to coordinate with the response curves of the attenuator, the amplifier, and so forth.

3. *Amplifier.* Amplifier trouble can cause either instrument insensitivity or high readings with no signal applied. The latter trouble can be caused by noise in the amplifier, shorted tube, or so forth. Amplifier tubes and components should have low microphonic characteristics. Some VTVM's have an over-all sensitivity adjustment for all scales, at all frequencies; this is a gain control on the amplifier. Poor low-frequency response can be caused by poor power-factor in cathode by-pass capacitors in the amplifier.

4. *Degenerative network.* The negative feedback in the VTVM is of great importance; it provides high-frequency response for the amplifier, and it compensates for the inherent discrimination against high frequencies within the attenuators and wiring. It also provides protection against meter damage due to overloads. The amount of feedback is

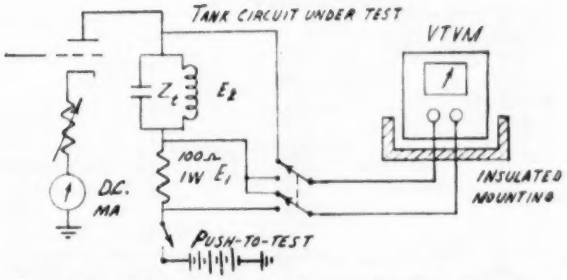


Fig. 3. Set-up for measuring resonant-circuit impedance, and approximate Q of tank circuit.

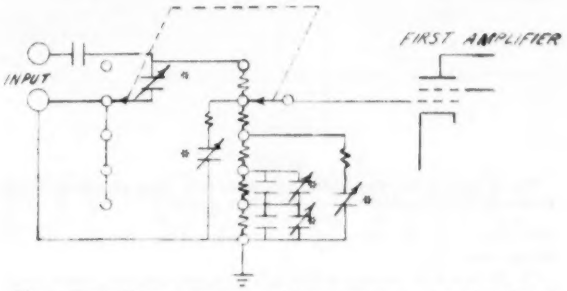


Fig. 4. Typical input attenuator with compensators, as used in Ballantine-type VTVM's. Compensation adjustments are marked with asterisk.

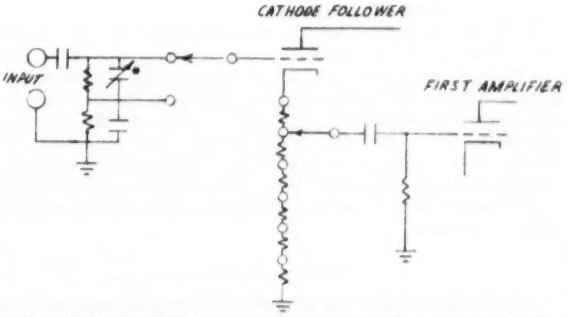


Fig 5. Typical attenuator and compensation network as used in Hewlett-Packard "Model 400C."

sometimes adjustable, but in event of persistent lack of response which cannot be compensated by attenuator capacitors, the feedback-circuit elements can be suspected. Over-all gain is sometimes adjusted by a feedback adjustment.

5. *Meter rectifier.* Fig. 6 shows typical meter-rectifier circuits. A variety of circuits, including series rectifiers, shunt rectifiers, and half-wave and full-wave types are in use in various commercial vacuum-tube voltmeters. In most, the combination of the meter-rectifier and the meter form a voltmeter, which is used to measure the voltage drop across a load resistor. Low readings, inaccurate trans-scale tracking, flutter, or vibration of meter can be caused by rectifier troubles.

6. *Indicator.* The indicator—a d-c. milliammeter—usually is chosen for ruggedness. Inaccurate readings on all scales at all frequencies, or improper trans-scale calibration, can be caused by indicator trouble.

Some suppliers of vacuum-tube voltmeters feature a special shaded-pole indicator which provides a logarithmic voltage scale and a linear decibel scale. This indicator has the advantage of linear increments between decibel steps, but the disadvantage that, with no "zero" point (the scale being calibrated from 1-10 for volts and the zero suppressed), it is necessary for the operator to make readings near the low end of the scale. (The scales do not overlap.) At the extreme low end of the scale there is little torque, either

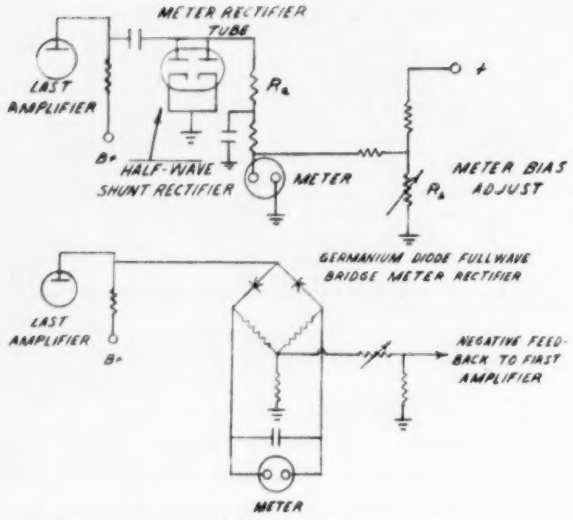


Fig. 6. Typical meter rectifiers. Top, diode type using 6H6 tube; bottom, germanium-diode full-wave bridge-rectifier circuit.

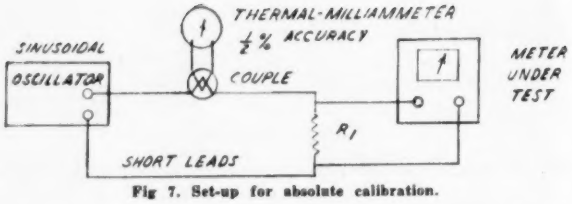


Fig 7. Set-up for absolute calibration.

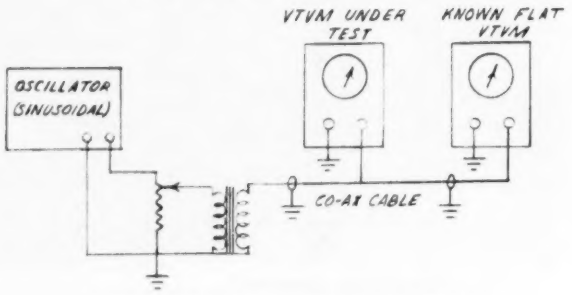


Fig. 8. Set-up for frequency-response check.

electrical or spring torque, to overcome friction in the meter bearings.

7. *Meter bias circuit* (Fig. 6). In many meters, some regulated d-c. potential is applied to the meter network to permit zero readings with no signal. This is required to balance the rectifier circuit and cancel the small no-signal voltages present in the circuit.

8. *Power supply.* The d-c. power supply for the amplifier tubes must be regulated and ripple-free. Inaccurate readings on all scales and at all frequencies can be caused by insufficient or incorrect plate voltages. Meter vibration or quiver can be caused by ripple in power-supply voltages. Some VTVM's provide direct current for amplifier filaments to minimize 60-cycle pickup in the amplifiers. Power-supply voltages should be checked under varying line-voltage conditions to insure proper operation of gas-filled regulator tubes or lamps.

Routine Service

These instructions are presented in step-by-step form. It is recommended that these operations be performed in sequence in scheduled service. Use caution as dangerous voltages are present. Ground the instrument to a good electrical ground.

I. Renewal of Vacuum Tubes

A. Check tubes in a good tester and renew those falling to 60 percent of rated mutual conductances.

B. Check each tube for microphonics by tapping on each tube as it is installed, and watching for meter deflection or listening at amplifier output. For this check the meter attenuator should be set on its most sensitive scale, and input terminals should be shorted.

C. Tubes showing microphonics (and otherwise good) sometimes may be used in other than first amplifier stages, thus saving tubes.

II. Physical Check

A. Pull power-line cord. Inspect for loose connections. The fact that an instrument has been in use for some time is no assurance against its having unsoldered connections or cold-soldered joints. *Look at every connection.*

B. Look for overheated or discolored components, and for cracked trimmer capacitors (ceramics).

C. Check for signs of misuse. Renew broken binding posts, replace missing screws, correct any effects of previous mis-handling. Clean inside and out. Clean meter glass.

D. Renew power cord if frayed. Tighten knob set-screws, and replace pilot lamp if necessary. Check fuse to conform with suppliers' ratings.

III. Check of Absolute Calibration.

A. *Allow 20-minute (minimum) warm-up time.* Calibration of absolute reading (low-frequency) of the instrument then can be accomplished with the instrument removed from its case if desired. The set-up for absolute calibration is shown in Fig. 7.

B. By choice of current through the thermo-milliammeter and of resistor R-1, select the range at which absolute calibration will be accomplished, preferably the most sensitive range. As the current-loop resistance is probably 1.0 ohm, use precautions in connecting the apparatus to insure no stray resistances. Connect with heavy bus-bar and make all connections *short and direct.*

C. Apply 100-cps. sinoidal signal to the test circuit and correlate thermal meter with meter under test. Adjust for correct reading by one of the following, depending on the type of adjustment provided by the manufacturer: (1) Adjust voltage gain of amplifier with gain control, if provided. (2) Adjust amount of negative feedback with control provided. (3) Adjust meter series-resistor, as at R_a in Fig. 6.

D. Meter now reads correctly for *one setting* of attenuator, at *low frequencies*, and at *one* portion of the meter scale.

IV. Check Cross-scale Tracking

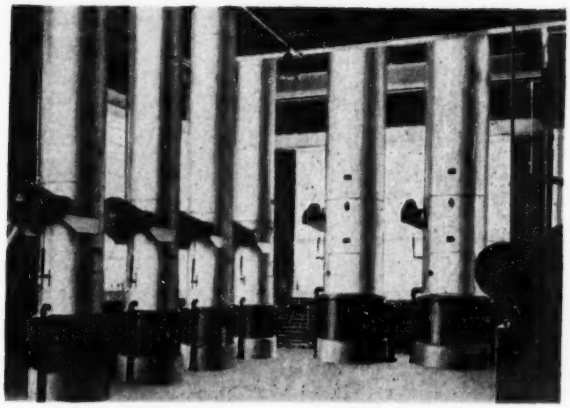
A. In instruments having a suppressed zero, this is a combined function of the meter-movement spring tension, and the meter bias adjustment (R_b in Fig. 6). As these meters have no meter zeroing screw brought out through the meter case, it is necessary to open the meter and make cut-and-trial adjustments of the meter torsion and the meter bias adjustment. Simultaneously check adjacent-scale overlap; 1.0 volt at low end of 10-V. scale must be equal to 1.0-volt at high end of 1.0-V. scale.

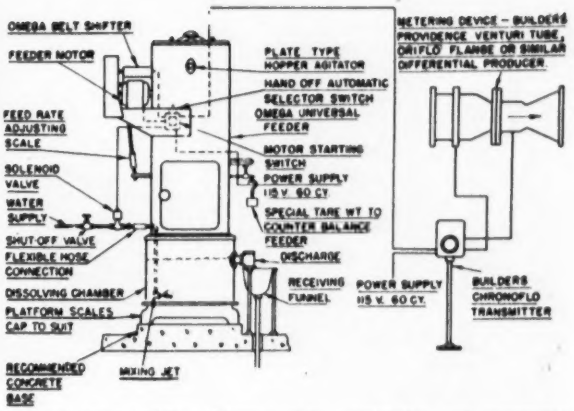
B. In instruments such as the Hewlett-Packard "400C," in which the meter is conventional, the trans-scale tracking can be adjusted by means of the meter-case zeroing screw, while re-checking the absolute reading as in III above.

C. Connect an oscillator (sinoidal) to the set-up and apply 1.0 volt. With meter on 1.0-volt full-scale setting, decrease the oscillator level in 0.2-volt steps across the dials. Observe tracking. Error in excess of 1 percent of full scale should be corrected.

D. While checking trans-scale tracking, simultaneously check movement for freedom from friction as follows: (1) At each step, as in C, above, approach each checkpoint from the higher end of the scale. At each checkpoint, gently tap the meter face. If friction exists, the pointer will drop

Continued on page 300




OMEGA BELT SHIFTER
FEEDER MOTOR
FEED RATE ADJUSTING SCALE
SOLENOID VALVE
WATER SUPPLY
SHUT-OFF VALVE
FLEXIBLE HOSE CONNECTION
DISSOLVING CHAMBER
PLATFORM SCALES CAP TO SUIT
RECOMMENDED CONCRETE BASE
MIXING JET
PLATE TYPE HOPPER AGITATOR
HAND OFF AUTOMATIC SELECTOR SWITCH OMEGA UNIVERSAL FEEDER
MOTOR STARTING SWITCH
POWER SUPPLY 115 V. 60 CY.
SPECIAL TARE WT TO COUNTER BALANCE FEEDER
DISCHARGE
RECEIVING FUNNEL
METERING DEVICE – BUILDERS PROVIDENCE VENTURI TUBE, ORIFLO FLANGE OR SIMILAR DIFFERENTIAL PRODUCER
POWER SUPPLY 115 V. 60 CY.
BUILDERS CHRONOFLO TRANSMITTER

The Omega Universal Feeder—Left, Hollingsworth & Whitney Co. water-treatment plant, Mobile, Alabama; right, construction and components.

CHEMICAL FEED CONTROL

Automatic proportional feed control from flow and pH instruments can be applied to volumetric and gravimetric chemical feeders.

by C. K. PERKINS and W. H. BROWN, JR.
Builders-Providence, Inc.

AUTOMATIC chemical control is important in water and waste-treatment plants. The metering instruments may be mechanical, electrical, or pneumatic.

Most chemicals used in water treatment can be fed with *dry-feed machines;* several types are available.

Volumetric dry feeders are usually electrically controlled. One type of electrical control is the "Chronoflo" or time-impulse method; the "Chronoflo" transmitter produces a signal that is directly proportional to the rate of flow. This control is applied directly to the chemical feeder. The usual cycle is 15 seconds, although a 60-second cycle sometimes is used. The signal energizes a solenoid which shifts a drive belt from a loose pulley to a drive pulley operating the feeding mechanism. The dissolving chamber, which is a part of the dry-feed machine, provides approximately 6 minutes detention, thus the intermittent operation is not apparent at the point of application.

Gravimetric dry-chemical feeders have higher first cost. However, they provide a more accurate feeding of chemical and frequently show considerable saving in chemicals used. This type of feeder also integrates the total amount of chemical fed by means of a totalizer mounted in the feeder.

Automatic control may be electric or pneumatic. Pneumatic control provides continuous feeding of chemical with the rate of feed controlled from the flowmeter or pH instrument.

Increased range of control can be obtained by using two variable-speed-drive units. The controlled air pressure is applied to one unit; the output shaft of this unit drives the second variable-speed transmission, which is manually set for the required dosage.

Lime slakers can be controlled like other dry-chemical feeders. However, the detention time of the slaker is about 30 minutes, and the required speed of response and rapidity of change in quality of influent must be considered. Frequently the capacity of the mixing basin does not provide sufficient detention time to permit this method of control. In this event the lime slaker is operated at a constant rate slightly greater than the maximum lime demand, with the slaker discharging into a lime-slurry tank. Mechanical agitation is provided in this tank to keep the lime in suspension. Operation of the lime slaker is stopped and started from a float switch mounted on the slurry tank. The lime dosage is controlled either electrically or pneumatically from a pH recorder-controller or flowmeter operating a valve in the discharge line from the slurry tank.

Automatic control is not limited to dry-chemical feeders; it can be applied to liquid feeders handling ferric chloride or other chemicals which must be fed as liquids. Several feeders may be controlled from one meter and it is not uncommon to extend the pneumatic control line to the chlorinizer. Thus the chlorine dosage is automatically maintained in direct proportion to the flow.

Presented at Conference on Instrumentation In Water Sewage and Industrial Waste Treatment, May 14, 1953, Manhattan College, N. Y.

Discussion by W. H. Brown

Mr. Perkins states that chemicals used in water treatment can be fed dry; the choice of wet or dry feeding depends on several conditions. Small plants requiring small amounts of chemicals usually mix their chemicals in batches and feed them by wet feeders. Larger plants using relatively large amounts, find it more economical to use the dry-type feeder which incorporates a dissolving chamber. If the chemical solution cannot be fed by gravity it is necessary to employ a wet-type feeder. However, it is rare when a dry feeder cannot be employed.

Mr. Perkins speaks of the speed of response required in a chemical feeder. Dry feeders require a dissolving tank of sufficient size, which introduces lag. This lag, however, is usually not objectionable, being only a few minutes. Wet feeders naturally respond instantaneously, injecting solution directly into the water.

Hoppers and solution tanks are necessary for automatic feeding. It is desirable to have these hoppers or tanks as large as practical. The fewer times per day or week that a hopper or tank must be loaded, the more likelihood there is of continuous, uninterrupted chemical feeding. Automatic chemical-feed control can hold operational costs to a minimum. The initial investment for automatic control equipment is usually returned many times over through the resulting saving in chemical cost.

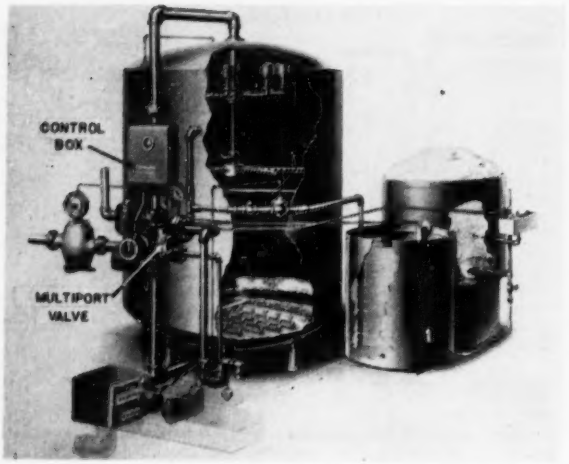


Fig. 1. Multiport valve of rotary-disk type installed on a pressure-type zeolite softener.

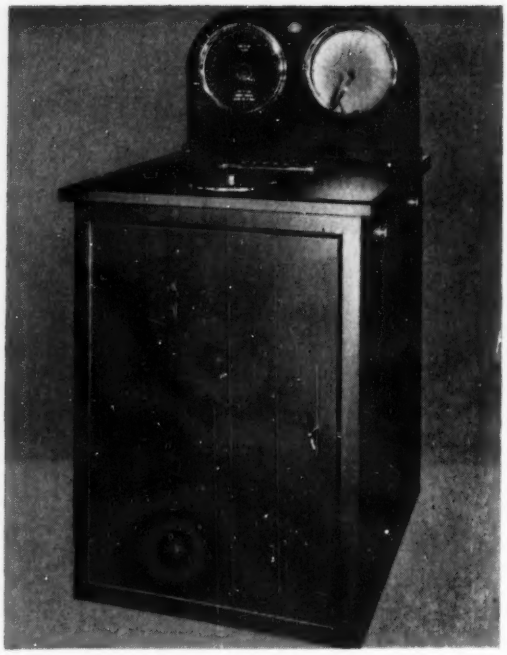


Fig. 2. Operating table for automatic gravity-type zeolite softener, showing pilot valve, valve-position indicators, flow meter, and loss-of-head-gauge.

Automatic Control for
WATER-CONDITIONING EQUIPMENT

Basic instruments on water-conditioning equipment include valves, pilot valves for control of the main valves, and instruments for flow, pH, and conductivity.

by CHARLES M. GULDNER
The Permutit Company

WATER CONDITIONING consisted, for many years, of coagulation and settling, filtration, chlorination, softening, or combinations thereof. However, use of higher steam pressures in power plants and the coming of new industries have produced more exacting requirements for the water supply, and have stimulated the development of new ion-exchange materials and various ion-exchange processes, including demineralizing. Demineralizing processes are capable of removing entirely the objectionable constituents of the untreated water. Similar ion-exchange processes have found application in other fields for purifying, concentrating, or recovering products in solution.

Early water-conditioning equipment involved simple control of water levels, pumps, chemical feeds, etc., and the manipulation of a few valves. As recently as 1934 little had been done to apply automatic control to the washing and regenerating cycles of filters and softeners.

The need of automatic control for filters, zeolite softeners, and ion exchangers is indicated when the reconditioning cycles must be carried out wholly in the absence of an operator, or when the size and number of units, or the frequency and duration of reconditioning cycles, are such as to burden operators.

Presented at Conference on Instrumentation In Water Sewage and Industrial Waste Treatment, May 14, 1953, Manhattan College, N. Y.

Operating Valves

Operating valves commonly used for automatic water-conditioning equipment are of three general types—(1) hydraulically operated gate valves, (2) motor-operated multiport valves, and (3) diaphragm-operated globe and Saunders-type valves.

The multiport type was designed originally for replacing the usual five- or six-valve nest on pressure filters and zeolite softeners. Their use has been extended recently to certain ion-exchange units having similar reconditioning cycles. A typical multiport valve of the rotary-disk type is shown in Fig. 1, with control box attached, installed on a zeolite softener. It is motor operated and automatically positioned. The attached control box contains the motor starter, timer, and control accessories. Practical considerations limit the multiport and globe-pattern diaphragm valves to a maximum of 6-inch pipe size, and the Saunders type to about 3-inch size for usual water-treatment applications.

Pilot Valves

Pilot valves are commonly used in water-conditioning equipment for the pilot control of main operating valves (cylinder- and diaphragm-operated types). They are of four classifications—(1) solenoid valves, (2) cam-operated pneumatic, (3) cam-operated hydraulic, and (4) disk-type hydraulic.

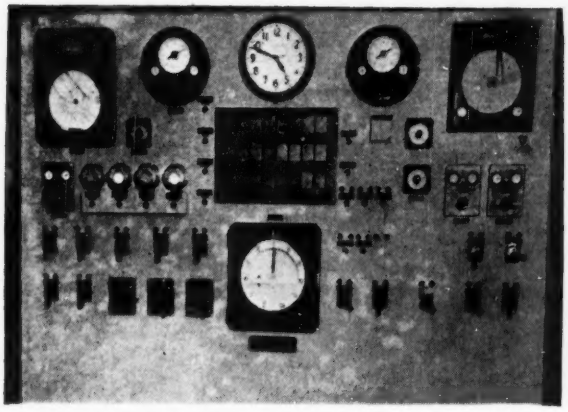


Fig. 3. Typical centralized control system using steel cubicle.

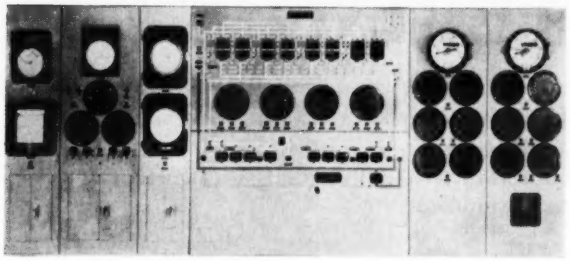


Fig. 4. Control cubicle for automatic non-water-treatment ion exchangers.

Solenoid valves are generally applicable to the control of small diaphragm valves.

Several instrument manufacturing companies market a pneumatic pilot valve consisting of a motor drive, a cam shaft, and a series of three-way pneumatic pilots, each of which can deliver to (or exhaust air from) the pilot line controlling a diaphragm-type main operating valve. These are applicable directly to water-conditioning units and ion exchangers using diaphragm valves. Their use can be extended to the control of large cylinder-operated hydraulic valves if a four-way diaphragm-operated auxiliary valve is used for each hydraulic valve cylinder.

A more direct method for controlling cylinder-operated hydraulic valves with water as the control medium utilizes a cam-operated pilot valve. It is shown on the front of the operating table in Fig. 2. The valve, designed especially for the service, has a motor drive, a cam shaft, and a number of valve units, each of which is essentially a four-way valve.

Pilot valves of the multiport rotating-disk type have been used for controlling hydraulic valves. However, the cam-operated pilot valve has the following advantages: (1) Special or complex sequences can be obtained by cutting of cams. (2) The cam-operated pilot valve can be installed in panels, control cubicles, and operating tables. (3) Less maintenance is required.

Multiport valves and pilot valves are controlled by various auxiliary devices—electrical relays, magnetic starters, timers, sequence switches, float switches, liquid level controls, or flow meters, as required by the application. They generally are purchased by water-conditioning-equipment manufacturers and built into their control systems.

Instruments

Instruments most commonly used in water-conditioning plants are flow meters, pH meters, and conductivity meters. In addition to totalizing or recording, they can control chemical feeding, proportioning of flows, initiation of reconditioning cycles, operation of alarms, etc.

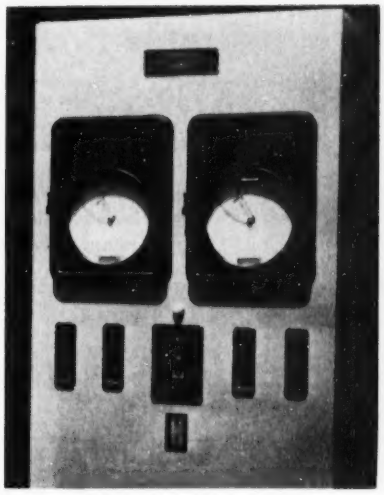


Fig. 5. Control cubicle for hot process softener. Instruments shown: Raw-water flow meter, temperature recorder, chemical feed timer and pump-control push-buttons.

Most water-conditioning plants should have an alarm system including such functions as indicating levels in storage tanks or chemical-solution tanks, end point of service runs for filters and softeners, failures of water pressure or power, high and low pH or conductivity, etc. An annunciator is ideal for the purpose.

Operating Tables and Panels for Gravity Filters and Softeners

Automatic gravity-type filters and softeners generally are provided with an operating table (Fig. 2) which contains the pilot valve and its electrical control, indicating lamps showing the open and closed positions of the hydraulic valves, a dial showing the operating position of the pilot valve, and instruments showing rate of flow and loss of head. Occasionally, in softeners, a flow meter operating from the effluent Venturi may be placed on the table also.

Vertical steel panels or cubicles also have been used recently for control of gravity filters and softeners. The steel cubicle or panel provides the most satisfactory means of installing the automatic control for a water-conditioning plant having considerable amount of electrical apparatus and instrumentation. A dust-tight compartment should be provided for the electrical apparatus and wiring.

Fig. 3 shows a typical control cubicle on which are installed the flow meters, sludge blowoff timers, chemical-feed timers, agitator and pump control switches, level indicators, annunciator, air loading panels, etc. The rear of the cubicle is completely enclosed. Enclosed conduits and tubing enter through the floor.

The steel cubicle method is advantageous because it permits factory assembling, wiring, and testing. This generally results in better workmanship at lower cost than is possible when the work is done in the field. The appearance is most pleasing and in keeping with modern techniques. The resulting centralization of instruments eases the burden on both operating and maintenance personnel.

Conclusion

Automatic control schemes for water-conditioning and other ion-exchange processes are many and varied. Some standardization of control for filters and zeolite softeners has been accomplished. However, the larger plants and the more complex water-conditioning processes generally require a combination of treatments in stages, repumping between stages, or blending of effluents. The application of automatic control to such plants is likely to require considerable instrumentation, electrical interlocking between stages, a control scheme for the pumping equipment, and a comprehensive alarm system. The possible variations in equipment are so many that a control center providing essentially automatic operation must be designed to suit the requirements of the individual plant.

JOURNAL of the
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Pipe-line-system

TELEMETERING

Impulse-duration-type telemetering is in extensive and growing use. Presented are the transmitter, receiver, transmission methods, installation and maintenance methods, and calibration technique for the time-impulse-duration telemetering equipment.

By GLEN C. WILSON
Southern California Gas Co.

TREMENDOUS EXPANSION in the use of natural gas throughout the country has brought about a proportional increase in use of telemetering equipment to measure and control remotely the large volumes and high pressures involved in the operation of "super-inch" pipe lines with many branches and exchange points.

Telemetering is not a new art. Water companies have used it to indicate water level in tanks and reservoirs since 1885. Power companies have been using it extensively since about 1912. Gas companies locally have systems that have been in service since the early 1920's.

Telemeters and remote or supervisory control make possible the centralization of measurement and control for an entire pipe line or distribution system. Stations previously requiring the station attendants on a twenty-four-hour three-shift basis are now entirely automatic, with all significant measurements telemetered to the central station where the operator may, through remote control, position valves, open or close line valves, fill holders, or check optional pressures or flows not normally telemetered.

Oil companies also are expanding their pipe-line facilities. Telemetering and remote control make possible many economies and improvements in their operation. Automatic booster stations are started and stopped by remote control, and the performance is checked by telemetering necessary measurements.

There is a tendency to regard telemetering and remote control as extremely complicated. However, large and seemingly complicated systems are only multiple installations of simple basic units, each of which are simple in principle, and sturdy and trouble free in operation. Fig. 2 illustrates a typical multiple telemeter and control installation.

There are many different methods of telemetering used by these various industries, but the method used most often in pipe-line measurement is the impulse-duration method.

March Meeting: Thursday, the 18th, Rio Hondo Country Club, Downey, Calif.
Feature: to be announced.

Impulse-duration Telemetering

In the impulse-duration system the transmitted signal has a duration which is proportional to the measured quantity. As the duration rather than the magnitude of the signal is used, the accuracy and reliability is not affected by considerable variation in either the resistance of the signal circuit or the voltage of the power source.

A simple example of the impulse-duration system is a telegraph circuit extending from a location where a pressure is to be measured to a point where the information is desired. By prearrangement, a signal of ten seconds would indicate a pressure of ten psi.; fifty seconds, fifty psi., etc. This is illustrated in Fig. 1.

In the impulse-duration telemetering system, the indicating gage, telegraph key, and the man at "A" are replaced by the telemeter transmitter. The telemeter receiver is located at "B."

Transmitter

Fig. 3 illustrates a transmitter. The transmitter consists of a cam rotated by a constant-speed motor, and a cam follower which is positioned by a measuring element. The cam follower slides over the surface of the cam rather than around the cam edge, as is usually done with cams.

When cam follower, or "rider," is off the cam, the switch is closed, thereby energizing the transmission circuit. The

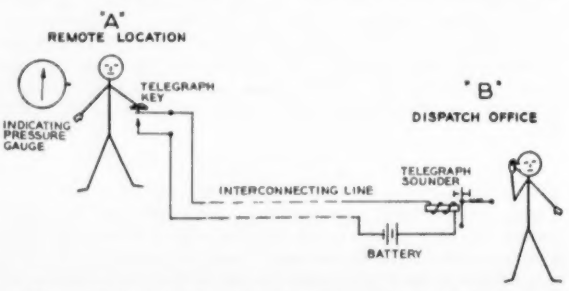

Fig. 1. Basic principle of the impulse-duration-type telemeter.

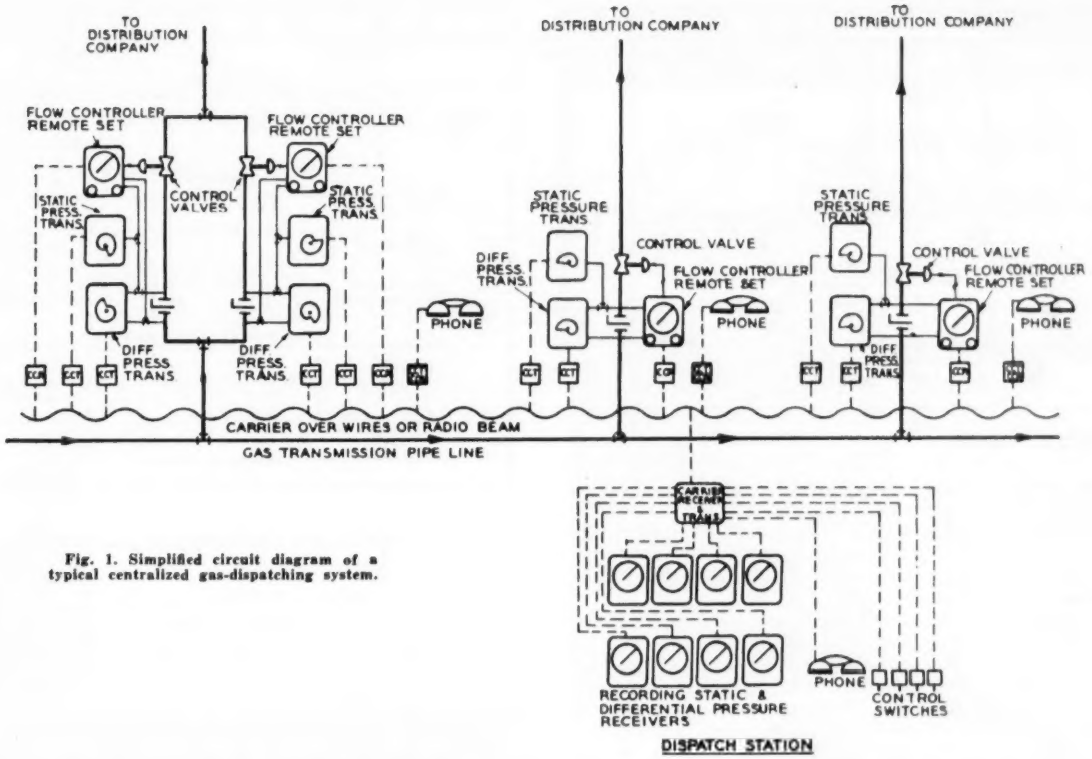

Fig. 1. Simplified circuit diagram of a typical centralized gas-dispatching system.

length of time the cam follower is off the cam—or the time the switch is closed—determines the time duration of the electrical impulse transmitted. For example, in the diagram titled "Low Pressure" in Fig. 3, suppose that the cam is revolving every 15 seconds. Suppose also, that at this low pressure, the rider is on the cam for ten seconds and off the cam for five seconds. Then, the duration of electrical contact, and consequently the duration of transmitted impulse, will be five seconds. Suppose that, in the diagram titled "High Pressure" in Fig. 3, the rider is off the cam for eleven seconds and on the cam for four seconds. Then, the duration of electrical contact and of the transmitted impulse will be eleven seconds. The diagrams at the lower right of Fig. 3 show the "on cam" and "off cam" time of impulse duration graphically for the given low- and high-pressure condition.

Receiver

At the receiving point, an electromagnet converts the electrical impulse into mechanical motion of its armature. The motion of the armature actuates a brake arrangement which moves an indicating pointer or recording pen up or down scale (Fig. 4).

During the cycle when no signal is transmitted a condition exists as indicated in position 1. The brake coil is de-energized, and beveled gear "A" is pulled by the spring against the beveled gear "M," which is mounted on the shaft of a constant-speed motor. When the transmission circuit is energized, the brake coil pulls gear "B" against gear "M" (position 2). Both gears "A" and "B" are mounted on the same shaft to permit shifting by the electromagnet, but are free to rotate with respect to each other. Arms mounted on gears "A" and "B" engage the pen arm, thereby positioning it to the correct location on the chart.

The lower sketch of Fig. 4 shows an isometric drawing of the gears and hairspring arrangement. Hairsprings return the gears "A" and "B" to their zero or indexing position each time they are disengaged from the motor drive. If, for example, in a system using a fifteen-second impulse cycle, a mid-scale impulse of 7½-second duration is received, gear "B" will rotate until the corresponding angular displacement is achieved and its arm has positioned the pen arm to mid scale. Then gear "B" is disengaged from the motor drive and is returned to its zero position by its hairspring. The pen arm position is held by a friction arrangement. During the remaining 7½ seconds of the cycle, gear "A" engages gear "M" and is rotated so that its arm comes up to the pen arm on the opposite side from which came arm "B," but does not move it. Therefore, the pen position will not be changed until the duration of impulse is changed by the transmitter in response to a change in the measured variable.

Transmission Methods

The interconnecting means between transmitter and receiver may be any of those shown in Fig. 5, or may be a radio link or channel. Recently, considerable work has been done with microwave transmission, in both the 960- and 2000-megacycle band. At these frequencies, antennas with parabolic reflectors are used, and the radio waves are beamed in a manner similar to that of a light beam from a search light; this transmission is often referred to as "line-of-sight" transmission*. Across level terrain, transmission over forty miles distance has been conducted without repeater or relay stations; if hills intervene, it is necessary to use relay stations. Microwave equipment suitable to impulse-duration telemetering is now available commercially.

Installation and Maintenance

Trouble-free service of any instrument requires correct installation practices followed by adequate preventive maintenance. Telemeters are no exception to this rule. The recommended practices relating to pressure piping and electric wiring should be followed scrupulously.

The high pressures encountered in transmission-pipe-line measurement require use of steel or extra-strength fittings and connecting piping. Electrical connections should be according to correct practice, using vapor-tight or explosion-proof fittings if required by code.

*Owing to pressure gradient in the atmosphere and other diffraction and refraction effects, radio-wave "line of sight" is about 15 percent greater than is the visual line of sight to the horizon.—*Ed.*

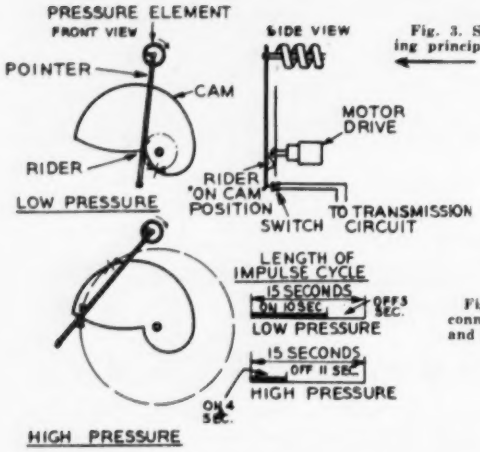

Fig. 3. Simplified diagram showing principle of transmitter.

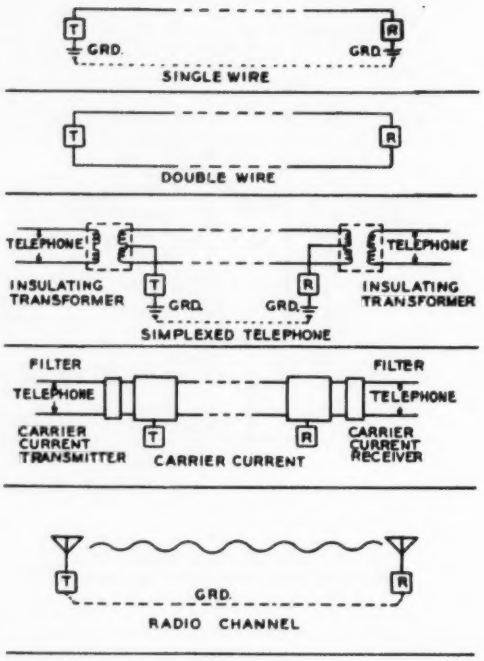

Fig. 5. Methods of interconnecting transmitter (T) and receiver (R).

All conduit to instruments containing pressure or control elements should include a vapor-seal fitting close to the instrument to exclude possible leakage into the conduit, and the case should be vented to a safe area. The larger the vent, the less the pressure will be inside the case in event of a ruptured pressure element.

In general, two types of routine preventive maintenance are recommended: (1) the monthly inspection, which includes a spot check of the calibration, cleaning and lubricating the face of the transmitter cam, inspection of the mercury switch for vaporized or dirty mercury, check of receiver operation, cleaning the pen, and checking the signal current, and (2) the yearly overhaul, consisting of disassembly, cleaning and lubrication of all mechanical elements, followed by a full-scale calibration.

Calibration

Full-scale calibration of telemeters—with the transmitters and receivers miles apart—is infinitely more difficult than the calibration of a conventional single-unit instrument. Therefore, the spot check is usually considered to be all that can be expected, unless the instruments are returned to the shop. On occasion, a number of spot checks will be attempted throughout the range of the instrument through telephone or radio contact. This requires the services of several qualified persons in close cooperation, and, as any one who has tried it will testify, leaves much to be desired.

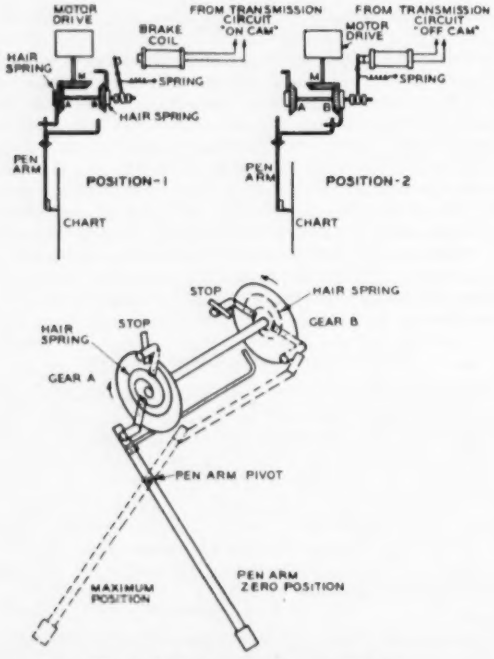

Fig. 4. Operating principle of receiver.

The Southern California Gas Company has developed and uses portable telemetering calibration standards. These instruments reduce the task of full-scale calibration to a relatively simple one-man operation, resulting in accuracy comparable to that expected of more conventional instruments. The portable calibrator consists, basically, of all of the elements of a complete telemetering system—that is, a manually positioned transmitter, a variable d-c. power unit, and a recording or indicating receiver unit, all in a portable gage case.

These calibrating standards are checked regularly against the timing standard of the impulse-duration system—that is, for a 15-second total cycle, an impulse of 3 seconds is equal to zero, a 7½-second impulse is equal to mid-scale, and a 12-second impulse is equal to full scale.

In practice, the calibrator is connected to the transmitter under test. For this, only the power and receiver units of the calibrator are activated, the current is standardized at forty milliamperes, and the calibration accomplished with little more effort or time than that required in calibrating a pressure gage.

As nearly all recording charts furnished by the manufacturer are of a standard lineal deflection for all pressure ranges, it is possible to simply change the receiver-unit chart for the corresponding range of the transmitter. It is realized that some minor differences do exist in charts of different range, but these are so small that they may usually be ignored.

The calibrator then is removed to the receiver location and the receiver under test is compared with the receiver unit in the calibrator. This is accomplished by connecting the entire unit in series with the receiver, the current is standardized as before, and the transmitter unit of the calibrator is adjusted manually to give the impulse corresponding to the desired calibration check points. Flow charts having wide centers are compared with readings from narrow-center charts of the same range.

These calibrators have many uses in trouble shooting and are used also as substitute receiver units while repairs are made on the regular receiver units.

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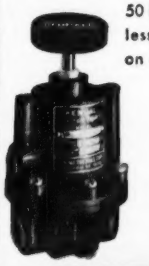

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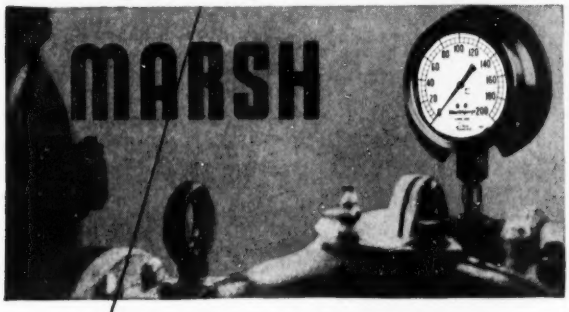

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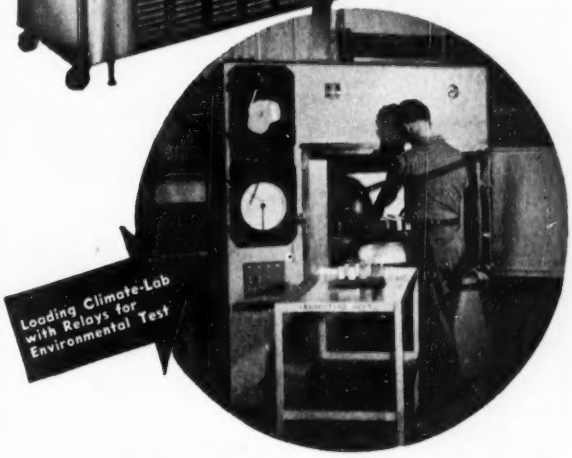
Equally adaptable to atmospheric corrosion studies, development and quality control.



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FOUR TYPES OF HUMIDITY-TEMPERATURE CONTROL

1. Constant humidity and constant dry-bulb temperature.
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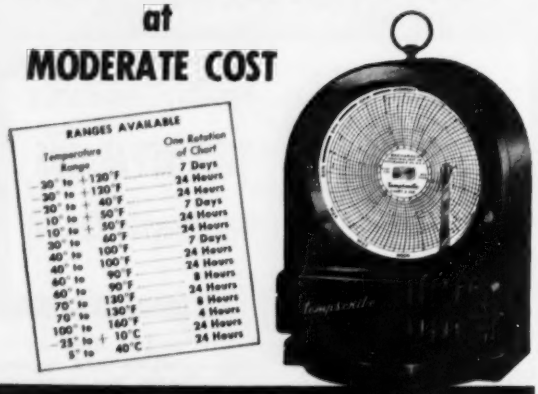

RANGES AVAILABLE	
Temperature Range	One Rotation of Chart
−30° to +120°F	7 Days
−30° to +120°F	24 Hours
−20° to + 40°F	7 Days
− 10° to + 50°F	24 Hours
− 10° to + 50°F	24 Hours
30° to 60°F	7 Days
40° to 100°F	24 Hours
40° to 100°F	24 Hours
60° to 90°F	8 Hours
60° to 90°F	24 Hours
70° to 130°F	8 Hours
70° to 130°F	4 Hours
100° to 160°F	24 Hours
−25° to + 10°C	24 Hours
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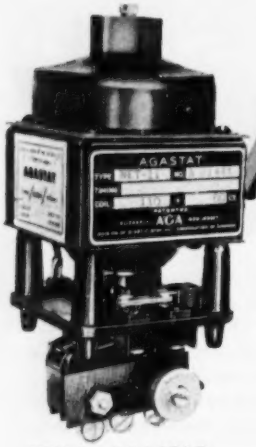

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Pioneers in pneumatic timing

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FILTER FIELD CONTROL

Continued from page 287

Automatic Control System

The pneumatic-type control system comprises (1) an electronic timer, (2) solenoid-operated valves, and (3) low-pressure air at 3-4 psi. The timer controls the valves which control the air under the siphon bells.

The electronic timer ("Model TS 4" made by Theodore Lovell) has two independent R-C timing networks. The controlled periods are sequential but independent. Periods of 50 seconds to ½ hour are possible. The timer has only four front-panel controls—one for each period and two for varying the multiplication of each period. The timer output is a relay that sequentially selects the solenoid valves in the pneumatic control circuit.

The basic time intervals are (1) time during which air is applied under the siphon bells and (2) time during which air is shut off and the air under the bell is withdrawn by venting to atmosphere. These intervals are adjustable in any desired ratio.

The valves used are made by Magnatrol Valve Corporation and are designed for continuous duty with solenoid housing 50 deg. C. above ambient.

Operating Cycle

With the time-constant circuits set to produce the frequency of nozzle discharge concomitant with process and volumetric input, the simple repetitive cycle is as follows: (a) Air supply valve closes. (b) Air exhaust valve opens, venting air from siphon bells to atmosphere. (c) Nozzle discharge from minimum to maximum radius is produced. (d) Air exhaust valve closes. (e) Air supply valve opens. (f) Nozzle discharge is progressively diminished from maximum to minimum and the cycle is completed.

[1]Montgomery, J. A., "A Discussion of High Capacity Trickling Filters, with Special Reference to Aero Filters," *Sewage Works Journal*, Vol. 13, No. 5, Sept., 1941, page 905.

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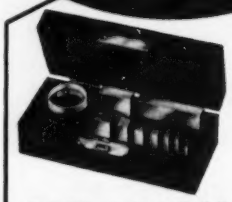

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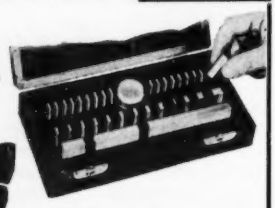

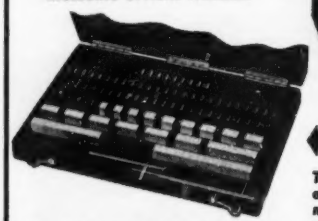

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INSTRUMENT EVENTS Calendar

March 1-5
Fifth Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy at William Penn Hotel, Pittsburgh, Pa. For information contact R. G. Russell, Gulf Research & Development Co., P. O. Drawer 2038, Pittsburgh 30, Pa.

March 8-10
Annual Conference and Exhibit, National Scalemen's Association, Edgewater Beach Hotel, Chicago. For information write Verne C. Kennedy, Jr., c/o Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

March 22-25
Institute of Radio Engineers Conference and Exhibit, Kingsbridge Armory, New York, N. Y. For information contact W. Copp, 1475 Broadway, New York, N. Y.

March 25-26
Third Conference "Instrumentation for the Iron & Steel Industry" sponsored by the Pittsburgh Section, Instrument Society of America. For information write Dr. A. Peterson, Mellon Institute, Pittsburgh, Pa.

April 6-9
Conference on Physics of Particle Size Analysis, sponsored by the Institute of Physics, Nottingham, England. For information write Institute of Physics, 47 Belgrave Square, London, S. W. 1, England.

April 14-16
Society for Experimental Stress Analysis Spring Meeting, Educational Lecture & Exhibit, Netherlands Plaza Hotel, Cincinnati, Ohio. For information write Harry LaTour, 134 Kensington Street, Middletown, Ohio.

April 19-20
Symposium on the Automatic Production of Electronic Equipment sponsored by Sanford Research Institute and U. S. Air Force, Fairmont Hotel, San Francisco, Calif. For information write L. K. Lee, Advanced Technique Group, Sanford Research Inst., Palo Alto, Calif.

April 19-23
Sixteenth session of the semi-annual X-ray Diffraction School at the plant of North American Philips. For information write Vern W. Palen, c/o North American Philips Co., Inc., 750 South Fulton Ave., Mount Vernon, N. Y.

April 22
Conference on Instrumentation in Water, Sewage and Industrial Waste Treatment, Manhattan College, New York City. For information write Brother Joseph McCabe, Civil Engineering Dept., Manhattan College, New York 71, N. Y.

April 22-23
American Institute of Electrical Engineers Conference on Feedback Control, Claridge Hotel, Atlantic City, N. J. For information write R. S. Gardner, A.I.E.E., 29 West 39th St., New York, N. Y.

April 22-29
American Institute of Electrical Engineers, Electronic Components Conference, Washington, D. C. For information write R. S. Gardner, A.I.E.E., 29 West 39th St., New York, N. Y.

April 28-30
Second Annual meeting of ASTM Committee E-14 on Mass Spectrometry, Jung Hotel, New Orleans. Louisiana. For information write J. G. Hutton, General Electric Co., Schenectady, New York.

May 5-7
Third International Aviation Trade Show, 71st Regiment Armory, New York. For information write Eugene P. Connelly, Aircraft Trade Shows, Inc., Hotel McAlpin, New York 1, N. Y.

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NOTE:
In above photograph, valves 1 and 3 are in NEUTRAL POSITION — Valve open and vent closed. Valve 2 is in TILTED POSITION — valve closed and outlet vented to atmosphere.

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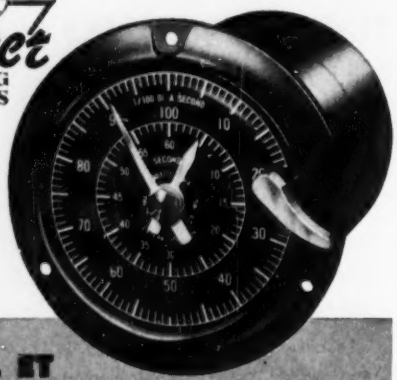

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AC VTVM

Continued from page 290

slightly. (2) In meters having suppressed zero, where readings are normally taken at the extreme low end of the scale, *check carefully* for friction near the low end.

3. Repeat friction check by approaching each check-point from the low end of scale and tapping at each point. Meter will rise slightly if pivots have friction.

4. Meters with friction that causes a pointer shift exceeding two or three thicknesses of the pointer should be corrected by a competent meter-movement technician.

V. Check and Compensate Frequency Response

A. Where extreme accuracy (less than ¼-db. variation) of frequency response is not required, the simplest method of flattening the response of the VTVM is first to use a linear test oscillator whose output over its range is flat to within a fraction of a db., or whose curve of output versus frequency is known. Response can be checked with the set-up shown in Fig. 7. The next article in this series will detail the procedure for lining up test oscillators.

B. After the test oscillator is flattened, and by using the thermo-milliameter with the oscillator level set at relatively high outputs, the same oscillator can be used to flatten the response of the voltmeter on all its ranges by adjusting the output level control to the desired level for each step of sensitivity of the VTVM.

C. Care must be taken to check the test oscillator often to insure its flatness. (For this operation the thermo-milliameter is the "standard" of frequency response and an instrument must be chosen which has a frequency range ample to cover the needs of the VTVM in question.)

D. An alternate method by which response can be calibrated is by use of a known flat VTVM, which can be a properly compensated oscilloscope. This may be set up as shown in Fig. 8.

E. In either method, the procedure used is determined

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If you believe you are qualified for any of these positions, please send a resume to Dept. D.

ENGINEERING IN DEPTH — Avien

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by the type of input attenuator and attenuator compensators. No attempt should be made to adjust the compensating capacitors unless the instrument is in its case and grounded. Each capacitor must be adjusted with the input attenuator set to its appropriate sensitivity. Once adjusted, and a step flattened at the high frequency, trimmers should not be adjusted again. Start with most-sensitive range and progress to least-sensitive range.

F. In extreme cases, aging of components may have caused a shift beyond the range of the capacitance variation of the trimmer capacitor. In this event a silver-mica padder of a few micromicrofarads should be inserted. However, before such a step is taken it is well to make sure that all steps were followed, that the absolute readings are correct, and that the comparison device for response is properly calibrated.

G. A flattened VTVM may not necessarily have a flat amplifier output; deliberate over- or under-compensation from amplifier input to and including amplifier output sometimes is provided to discriminate against an inherent frequency characteristic in the meter-rectifier circuit.

VII. Run-in and Final Check

A. Re-check inter-scale overlap, or inter-scale correlation; Check this carefully at 100 cps. If there is a discrepancy, the trouble is in the attenuator network or in the meter.

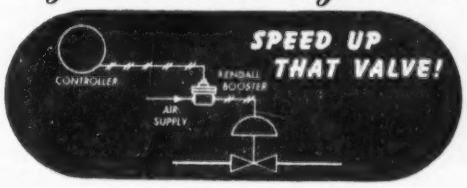
B. Repeat tests at a higher frequency, such as 100 kc. If there are discrepancies the instrument was not properly compensated.

C. Re-check for microphonics and noise by shorting input, setting attenuator to maximum sensitivity, and tapping case. No deflection of meter should occur. Meter should go to almost zero and readings must be steady with no input and input terminals shorted.

D. Re-check for friction, placing instrument in several different physical positions.

VIII. Enter Data to card file system. Post tubes and components on record cards.

Engineered Air Regulation



We say—**it's easy and inexpensive to minimize valve response lag in even the biggest diaphragm motor or cylinder type actuator when a KENDALL Booster triggers the action.**

Prove our statement by testing this air volume amplifier on your most sluggish valve.

Write for Bulletin 4522 describing the Kendall Model 20 Precision Air Volume Booster with its

- **High capacity – both supply and relief**
- **Perfect balance against supply pressure changes**
- **Precise ratios**

Ratio No.	Loading Pressure	Output Pressure
1	Each 1 PSI	produces 1 PSI
1/2	" 1 "	" 1/2 "
1/3	" 1 "	" 1/3 "
2	" 1 "	" 2 "
3	" 1 "	" 3 "

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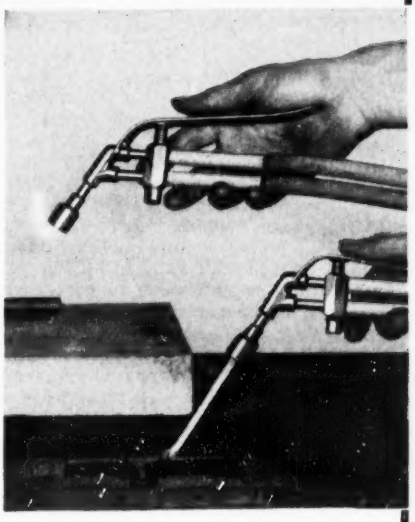
to **BRAZE, SOLDER** and for other heating purposes where quick control from low flame to instant blast is needed.



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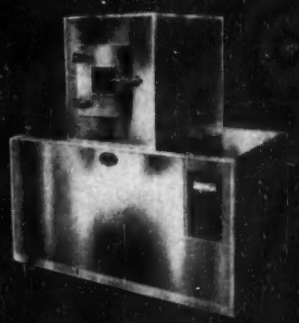
TEST CHAMBER
WITH
HIGH-TEMPERATURE,
LOW-TEMPERATURE
AND HUMIDITY



★ This Webber test unit, designed for production and experimental testing, has a temperature range from +250°F., to −100°F. The pull-down to −100°F., is achieved in 45 minutes, and can be cycled from −100°F., to +250°F., in 30 minutes. 95% relative humidity is provided at temperatures between 75°F., and 95°F. Vacuum equipment can be added to simulate high altitudes. The test chamber, provided with a moisture-proof light for illumination, is 4½ cubic feet, 20 inches high, 20 inches wide, 20 inches deep. High and low temperatures are governed by a temperature controller with scale range from −200°F., to +400°F., with a 3 degree control point differential, 1½ degrees plus and minus. The humidity is regulated by a wet and dry bulb controller. Unit size is 60" long, 45" wide, 74" high. Apertures in left side of cabinet provide for electrical cables to energize equipment being tested. Webber offers a complete line of test units for various applications.

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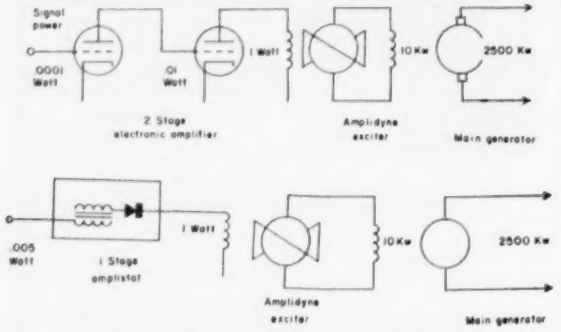
Briefs . . .

Amplidyne

One of General Electric's most important contributions to the science of Electrical Engineering is the AMPLIDYNE. The amazing results which can be achieved with the amplidyne challenge the imagination. Basically, the amplidyne

POWER LEVELS OF TYPICAL AMPLIDYNE-ELECTRONIC AND AMPLIDYNE-AMPLISTAT SYSTEMS



is an externally driven d-c generator. However, its unique use of a short circuit and compensating winding creates such precise electrical balance that the smallest electric signals release *kilowatts* of output capable of controlling the most powerful machinery.

The reference for an amplidyne system is applied to a reference control field. The reference is set by the operator to call for a particular output.

The control system is designed to hold the output as nearly equal to the reference as possible. Thus it is necessary to amplify the difference between the reference and the feedback so that it may be used to control the output. This is the function of the amplidyne—to compare the reference and the feedback, and amplify the difference. (*From new 24-page Brochure "The Amplidyne," General Electric, Schenectady, N. Y.*)

For this literature circle **575** on inquiry card.

Plane-Grating Spectrograph

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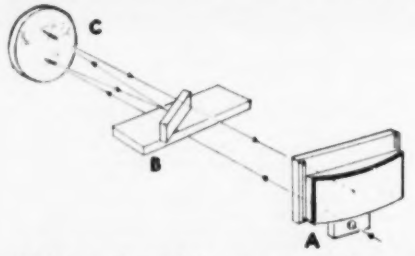


order to 600,000 in the eighth order. Resolution is guaranteed to be 100,000 at 3000A while the practical speed equals the famous JAco Wadsworth Grating Spectrograph.

In addition to the 15,000 line/inch grating normally provided, 7500 line/inch and 30,000 line/inch gratings are also available. The coarser ruling is used for problems where wide wavelength coverage is essential and the 30,000 line/inch grating produces high dispersion in the first order while eliminating the possibility of overlapping wavelengths.

The light from the slit (A) passes under the plane grating (B) to a large mirror (C) which renders it parallel and reflects it back to the grating. The light returned by the grating consists of parallel bundles of rays for each wavelength, the separate bundles at diverging angles in accordance with the dispersion of the grating. These rays strike the upper part of the concave mirror, which now acts as a camera mirror to focus the rays on the plateholder, back above the slit. Because the rays for the differing wavelengths diverge, this section of the mirror has to be large. The collimating mirror used is 16" in diameter to cover a 30" plate. (*From new 4-page Catalog EB-10, Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.*)

For this literature circle **576** on inquiry card.

Computing with Servo-driven Potentiometers

In analog computation the primary method of performing nonlinear operations continues to be the servo. This article will touch briefly on the important considerations involved in computing with servo-driven resistance potentiometers

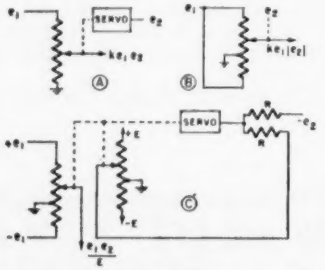


Fig. 1: Servo-driven potentiometer multiplier types: (A) basic, (B) absolute, (C) follow-up

including a good deal of material on the unloading problem and a discussion of the most effective ways of using feedback amplifiers to achieve multiplication and division in a manner that is almost completely free of loading error.

The procedure for multiplying variables consists of exciting a servo-driven potentiometer with one variable voltage and positioning the potentiometer arm in accordance with the other variable voltage (see Fig. 1a). The voltage at the arm is proportional to both voltages and accordingly to their product. The proportionality constant is equal to the reciprocal of the full scale value of e_2. Fig. 1c shows, in block diagram form, a potentiometer follow-up type of servo multiplier, called a four-quadrant multiplier since both variables can change signs. An occasionally helpful device is indicated in Fig. 1b where an absolute value term is generated. (*From new 8-page Bulletin 204, Helipot Corp., S. Pasadena, Calif.*)

For this literature circle **577** on inquiry card.

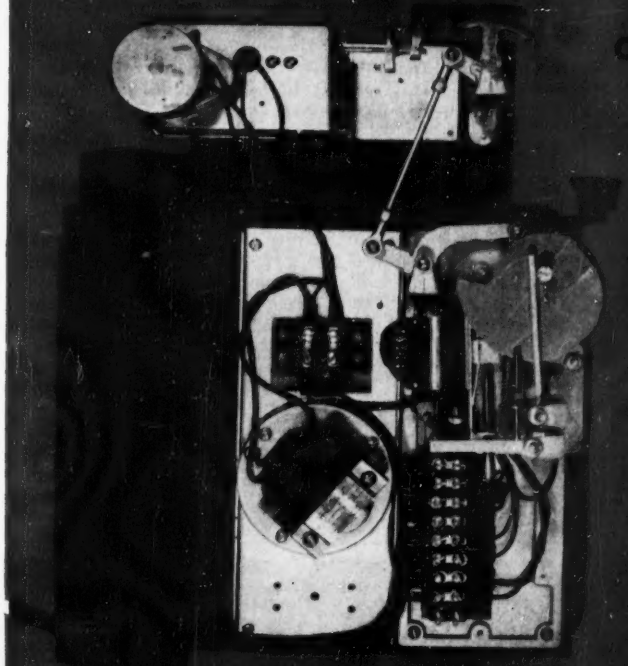
Thermal System Selection

Vapor-Filled Systems	Mercury-Filled Systems
1 Filled with organic fluid and its vapor.	1 Filled with triple distilled mercury.
2 Smallest bulbs.	2 Higher and lower temperature ranges.
3 Spiral and tubing inherently free from effects of ambient temperature changes.	3 Case-compensated for ambient temperature changes.
4 High end of scale has widest scale spacing; allows greater readability in this region.	4 Evenly spaced scale marks.
5 Not recommended for cross-ambient measurement because of time lag.	5 Bulb can be as much as 30 feet higher or lower than case.
6 Choice of copper, steel or 18-8 stainless steel bulbs.	6 Bulb material is 18-8 stainless steel.

(*From new 10-page Bulletin 6401, Minneapolis-Honeywell, Ind. Div., Phila. 44, Pa.*)

For this literature circle **578** on inquiry card.

a new electronic flow meter!



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continuous integration —no creep at zero

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3 to 1 range calibration at recorder

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Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

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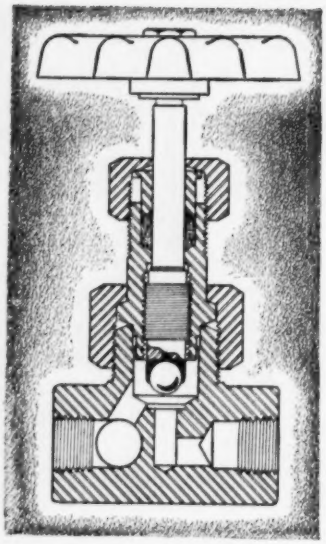
for air lines, meter manifolds, pressure gauges, other services



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Foxboro Ball Valves handle pressures to 3000 psi. Available in straight-thru and angle types. Two or four connections to simplify piping. ¼" size. Write for detailed folder.

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FOXBORO INSTRUMENTATION

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TYPE M 1243
DELAY MULTIVIBRATOR

The Walkirt Type M 1243 Delay Multivibrator is one of several stock delay units providing an externally variable delay pulse.

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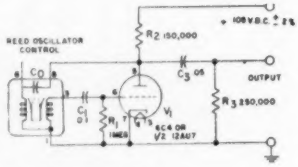
BRIEFS—CONTINUED

Oscillator Control

The Frahm Oscillator Control is a miniature tuning fork for use in an electronic oscillator to provide a stable output frequency. By its use, a good sine wave signal with an output better than 1 volt can be obtained. Controls are available for any frequency in the range 50 to 1000 cps., with accuracies in the order of 0.1 percent. (*From new 4-page Bulletin* 34-10, *James G. Biddle Co.*, 1316 *Arch St., Philadelphia, Pa.*)



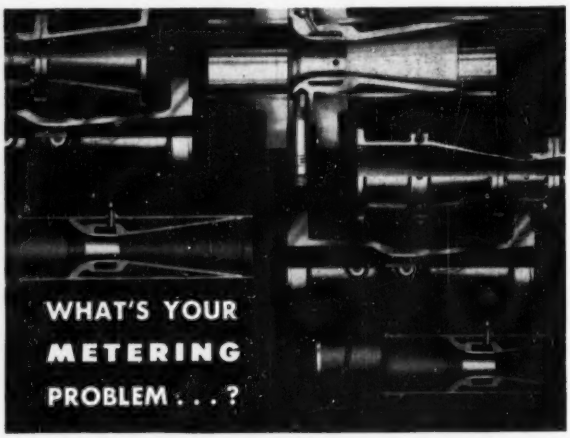
For this literature circle **579** on inquiry card.

Molybdenum Permalloy Powder Cores

The first commercial loading coil cores were made from 4-mil iron wire formed into a toroidal core . . . used several miles of wire . . . had a permeability of about 65 . . . were standard by 1904. The Western Electric Co. produced loading coil cores from powdered iron.

In 1928 Shackleton and Barber announced the use of permalloy, an 80-percent nickel-iron alloy for compressed powdered cores . . . with a permeability of 75 . . . permitted reduction in core size. In 1940 Legg and Given announced commercial use of molybdenum permalloy . . . 2-81 contains 2-percent molybdenum, 81-percent nickel and the balance iron.

The cores produced by this process, under license arrangements with Western Electric Company, are made in four



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For more information circle **120** on inquiry card.

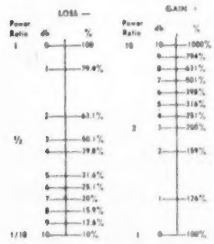
standard permeabilities, 125, 60, 26, and 14. The 125 permeability cores are normally used at frequencies up to 15 kc; the 60 permeability cores from 10 to 50 kc; the 26 permeability cores from 30 to 75 kc; and the 14 permeability cores from 50 to 200 kc.

Among the outstanding features of this type of core are its constancy of permeability over a wide range of flux density. The high value of permeability obtained (125 as compared with 75 for permalloy and 35 for powdered iron) makes possible high quality coils for audio-frequency work. These cores are characterized by high electrical resistivity and low hysteresis and eddy current losses. The combination of properties has permitted use of these cores in repeater coils and high pass, low pass and band pass filters where high values of Q are required. In noise suppression filters, molybdenum permalloy powder cores have been used at frequencies up to 1000 Mc. They have also been used in decade inductors and resonant circuits. (*From new 16-page Bulletin PC-104, Arnold Engineering Co., Marengo, Ill.*)

For this literature circle **580** on inquiry card.

The Decibel

Decibel values, being logarithmic quantities, can often become confusing and misleading unless one has been using these units regularly. For example, values of 10 db or 20 db correspond to a power ratio of 10 to 1 and 100 to 1, respectively, and values of 30 db, 50 db, and 100 db, while being relatively small numbers themselves, represent tremendous changes in power levels. Less confusion will result if one will remember that a 2 to 1 (or 1 to 2) power ratio represents approximately a 3 db change and that a 10 to 1 (or 1 to 10) power ratio represents a 10 db change. Points in between these two values may be "guesstimated" within a



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On any air or gas line 92% of the dirt, oil, scale and water that enter the Aridifier is trapped and removed from circulation. The Aridifier's patented centrifugal-baffle action scrubs air and gas clean and dry . . . protects equipment, prevents freezing, fouling, corrosion and caking, produces best results with spray gun and air tool operations, etc. Easy to install. Self cleaning. Maintains itself. 10 models available. Capacity 7 CFM to 17,000 CFM.

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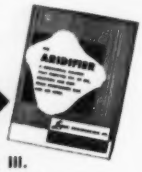

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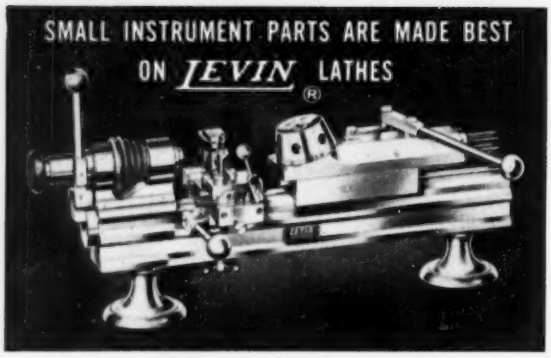

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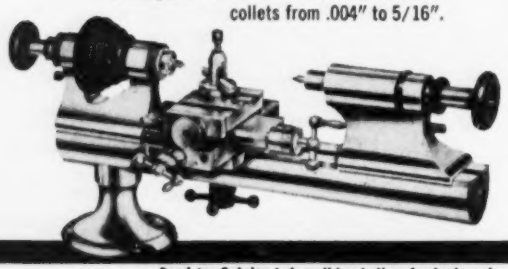

Send for Catalog L describing Lathes for tool work, second operations; turrets and full line of accessories.

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For more information circle 125 on inquiry card.

BRIEFS—CONTINUED

few per cent without too much trouble. The following table showing power ratios as db values compared to percentage changes vividly illustrates the difference between the two. It is based on a 1 to 1 ratio, or 0 db, as representing a 100 percent level. (*From new Vol. 6 No. 6 issue of "Engineering News," American Phenolic Corp., Chicago 50, Ill.*)

(*Editor's note*: As power ratio in db is 10 log P_1/P_2, and as voltage ratio in db is 20 log E_1/E_2, a 50-percent power drop is about 3 db, whereas a 50-percent voltage drop is about 6 db.)

For this literature circle 581 on inquiry card.

Transistor Supplies

With the development of transistor operated devices there is a growing requirement for small batteries of top quality construction, capable of maintaining uniform sustained voltage for long periods of operation under low drains and retaining fresh power over long periods of non-usage. Some alkaline type cells which have found limited use in recent years where heavy loads permitted only short service are not suitable for the long service requirements of the transistor. The miniature "N" cell retains its superior staying power because it is mechanically capped with an airtight polythene seal. (*From new 4-page brochure "Power Supplies for Transistors," Burgess Battery Co., Freeport, Ill.*)

For this literature circle 582 on inquiry card.

Lags and Controllability

Conclusions drawn from a study of the effects of transmission lags on controllability include:

Dead period lag and *reaction rate slope*: Both are increased as (1) total transmission tubing length is increased,

"Helinews"

Electrical Noise in Wire-Wound Potentiometers

by Irving J. Hogan

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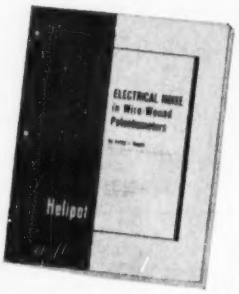

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. . . *first in precision potentiometers*

235

For more information circle 126 on inquiry card.

(2) as downstream volume of controller is increased, and (3) tubing is placed between controller and controller valve (rather than between transmitter and controller).

Sensitivity: Ratio of optimum process sensitivity to ultimate sensitivity approximates a constant. Ultimate sensitivity of a flow process can exhibit minimum value at a specified length of tubing—depending on the time constants in the control loop.

Reset Rate: Increase of transmission tubing length causes (1) decrease in optimum reset rate and (2) decrease in ultimate period.

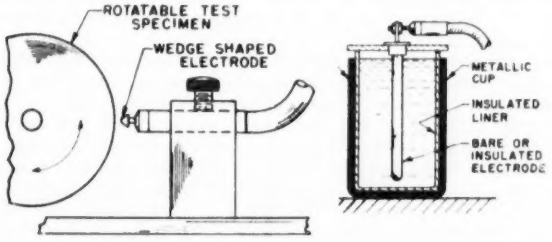
Primary Oscillation: Primary oscillation amplitude ratio of receiver-controller to transmitter decreases as tubing length increases. Chart records often present an erroneous picture of a process load disturbance. (*From "Taylor Technology," Vol. 6, No. 2, Taylor Instrument Co's., Rochester 1, N. Y.*

For this literature circle **583** on inquiry card.

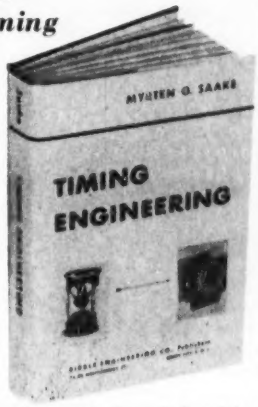
Proximity-Capacitance Gage

An extraordinary feature of the Capacitance Gage is that measurements are made without any physical contact with the specimen. Variations in the order of one hundredth of a microinch may be detected.

The instrument is applicable to unusual measurements of dielectric change, which is useful for product composition,



If your problem is *Automation* by *Timing* you will want . . .



The first complete, full length reference book on industrial timers and applications. TIMING ENGINEERING is an authoritative volume on basic design, construction and application of timers in relation to *Automation* of machinery and processes. TIMING ENGINEERING places emphasis on "how to do it"—from the simplest to most complex application—by circuit diagrams. Techniques are shown for combining timers with counters to achieve automatic control.

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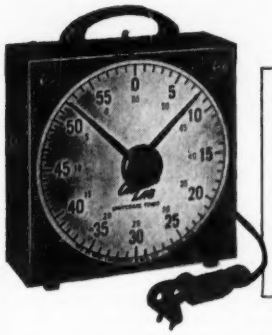

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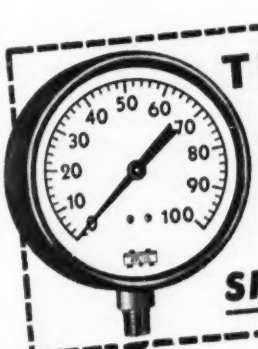

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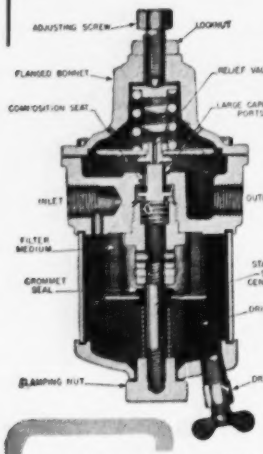

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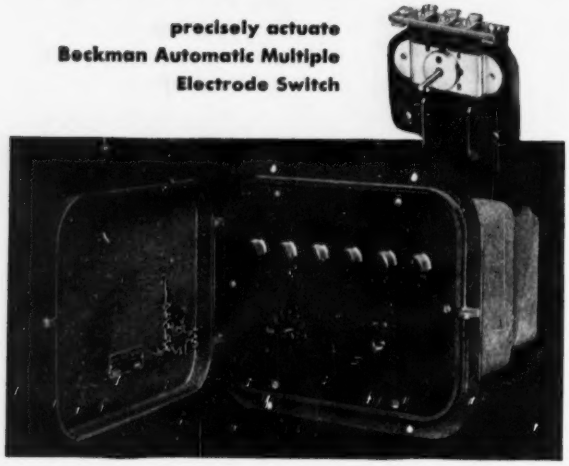

Featuring a stack of high insulation switches for connection of six electrodes to a single meter, this Beckman multiple switch is driven by a Barcol AYAG continuous duty reversible motor. For positive operation of your instruments, too, there's a wide line of rugged, high-torque Barcol Small Motors . . . unidirectional, synchronous, and reversible . . . with or without reduction gearing . . . up to 1/30 hp.

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For more information circle **131** on inquiry card.

BRIEFS —CONTINUED

moisture, product contamination, and many other special studies.

Illustration at left shows use as a concentricity gage; right shows use as a dielectric comparator. Other uses include paint or insulation thickness gage, strain gage, surface gage, dynamic or static torque meter, auto weigher, and other applications. (*From new brochure "Proximity Meter," Fielden Instrument Div., 2920 N. 4 St., Phila., Pa.*)

For this literature circle **584** on inquiry card.

Hermetic Sealing

Kovar is the ideal alloy for sealing to hard glass . . . Available in the form of rod, wire, sheet, foil . . . Seals are permanently bonded chemical interaction of the oxide of Kovar fused with hard boro-silicate glass. (*From new 36-page Catalog 453 of Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.*)

For this literature circle **585** on inquiry card.

Machine-tool Automation

A servo-control system on a machine tool operates the machine mechanisms according to "commands" or "information" which is "stored" in a manner suitable to the system being used. A Turchan hydraulic system, in most cases, uses an ordinary flat template bearing the contour of the part required. Many times the part itself or a model of it may be used as a template to produce duplicate parts.

Other types of systems may also use templates, but some of them require different storage methods of varying complexity, as magnetic tapes, analog computers, punched cards, and paper tapes—even movie film. (*From new 24-page Brochure 3/TU, "Automation of Machine Tools," Turchan Follower Machine Co., 8257 Livernois Ave., Detroit, Mich.*)

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For more information circle **132** on inquiry card.

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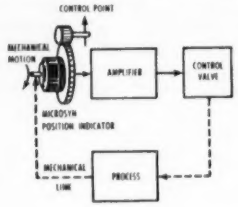
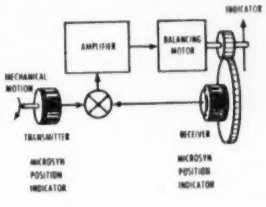
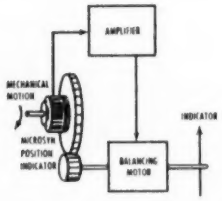
The Microsyn Position Indicator is a small electromechanical signal generator which transforms angular displacement into an electrical signal. Accurate and dependable,



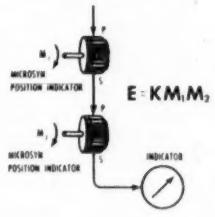
Process Controller



Linear Balancing System



Self-balancing Servo System



Multiplication of Variables

this precision instrument has been used extensively in fire control computers and gyro instrumentation. Now available for industrial use, the Microsyn offers a new level of instrument performance to designers of indicating and control equipment in the chemical, refinery and process industries. (*From new Bulletin MP, Doelcam, Corp.*, 1400 *Soldiers Field Rd., Boston* 35, *Mass.*)

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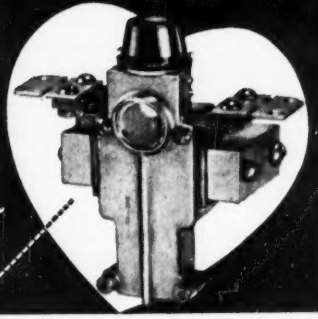

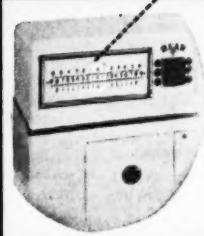

IN THE AUTOMOTIVE FIELD, the Bear Manufacturing Co. of Rock Island, Ill. uses Series 500 G-M Galvanometers in its new remote-reading Electric Wheel Alignment System (left). Whatever your own particular instrument field, you can achieve this same self-contained portability, ruggedness and high sensitivity with G-M Galvanometers. Complete catalog on request.

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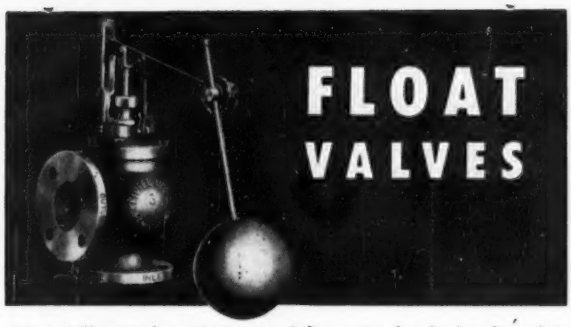

No. 77 illustrated — Single seated float valve for dead end service. Internal pilot control. 250 lbs. max. inlet pressure. Does the job of more complicated control valves at a much lower cost wherever tight closing float valves are required for make-up water control. Sizes 2" — 8". Other types. Get BULLETIN 349.

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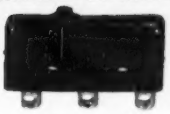

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MANUFACTURERS' NEW LITERATURE

In this department we report new literature, pertaining to instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on Page 323.

Requests for literature FROM ABROAD should be made on company letterhead and mailed DIRECTLY to the manufacturers.

AUTOMATION

Amplidyne Generator. New 24-page illustrated Bulletin GEA-4053 gives principles of operation, applications, and photographs of maker's "Amplidyne" externally driven d-c. generator that converts small electric signals to kilowatt signal, for controlling power machinery.—General Electric Co., Schenectady 5, N. Y.

Circle **401** on inquiry card.

Process Control. New 20-page illustrated Catalog 2 covers description, specifications and sizing nomographs for maker's flow meters, recorders, controllers, and chemical feeders. —Fischer & Porter Co., 924 Jacksonville Rd., Hatboro, Pa.

Circle **402** on inquiry card.

Combustion Control. New 8-page illustrated Bulletin R-9 presents case history of boiler-plant installation employing maker's combustion control apparatus to enable user to switch fuels easily and obtain high efficiency. —Hays Corp., Michigan City, Ind.

Circle **403** on inquiry card.

Machine-tool Automation. New 24-page Bulletin 3-Tu describes and illustrates maker's automatic control systems for machine tools and automatic servo-controlled machine tools.—Turchan Follower Machine Co., 8257 Livernois Ave., Detroit, Mich.

Circle **404** on inquiry card.

Servomechanisms. New 20-page illustrated Bulletin S-3 presents multiple-mode operation of servomechanisms.—Cook Electric Co., 2700 Southport Ave., Chicago, Ill.

Circle **405** on inquiry card.

Servomechanisms. New 36-page illustrated Bulletin S-2 presents nonlinear techniques for improving servo performance.—Cook Electric Co., 2700 Southport Ave., Chicago, Ill.

Circle **406** on inquiry card.

Positioner. New 4-page illustrated Bulletin 473 presents characteristics, operation, performance and specifications of maker's power-position relay.—Foxboro Co., Foxboro, Mass.

Circle **407** on inquiry card.

Control Panels. New 10-page illustrated bulletin gives photographs of maker's switchboards and industrial control equipment.—Lake Erie Electric Mfg., 2952 W. 22 St., Erie, Pa.

Circle **408** on inquiry card.

Acid Waste Neutralizing. New 2-page issue of "Application Engineering Data" (833-5) describes and illustrates method of acid waste neutralizing with spent alkali.—The Foxboro Co., Foxboro, Mass.

Circle **409** on inquiry card.

VALVES

Relief-valve Handbook. New 16-page bulletin explains and illustrates function of relief valves, both temperature and pressure, and A.G.A. and A.S.M.E. requirements.—A. W. Cash Valve Mfg. Corp., Wabash & Morgan, Decatur, Ill.

Circle **410** on inquiry card.

Cylinder Valve Actuators. New Applications Sheet No. 3001 diagrams and explains automatic safety shut-off of pneumatic actuators in event of line failure. Application Sheet no 3002 shows how instrument air can be used to control valve actuators.—Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles, Calif.

Circle **411** on inquiry card.

Check Valves. New 4-page Catalog Section 1 presents maker's twin-seal check valves.—Mansfield & Green, Cleveland 14, Ohio.

Circle **412** on inquiry card.

Safety Valves. New Folder contains Bulletins 103, 104, 105, 107 and 112 giving descriptions and specifications of maker's excess flow, instant-closing solenoid-controlled, shut-off, high or low pressure shut-off and piston-operated swing-check control valves.—McRae Valve Corp., 621 S. Spring St., Los Angeles, Calif.

Circle **413** on inquiry card.

Valves, Seals. New 100-page catalog describes and illustrates maker's check valves, hand pumps, diaphragm seals, and pressure instrument test unit.—Mansfield & Green, Cleveland 14, Ohio.

Circle **414** on inquiry card.

Four-way Solenoid Valves. New 6-page illustrated Bulletin 25 covers operation features, characteristics, operating range and basic types of maker's solenoid-controlled ¼-in. directly-operated 4-way valves.—Pantex Mfg. Corp., Pawtucket, R. I.

Circle **415** on inquiry card.

RECORDING

Oscillography. New 12-page issue of "Hathaway Engineering News" (Vol. 3, No. 3) features article on "Model S12" 12-channel oscillograph.—Hathaway Instrument Co., 1315 South Clarkson, Denver, Colo.

Circle **416** on inquiry card.

Potentiometer Recorder. New 2-page Data Sheet 10.0-14 describes maker's "ElectroniK" high-impedance input instrument for use with source impedances varying from 0 to 50,000 ohms.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Circle **417** on inquiry card.

Oscillographs. New 4-page illustrated Bulletin G.C.3 covers descriptions and specifications of maker's recording oscillographs and accessories for data-recording.—Edin Co., Inc., 207 Main St., Worcester, Mass.

Circle **418** on inquiry card.

Portable Tape Recorder. New 2-page Bulletin 5415 describes and illustrates maker's "Flyweight Magnemite" battery-operated electric-motor portable magnetic tape recorder.—Amplifier Corporation of America, 398 Broadway, New York, N. Y.

Circle **419** on inquiry card.

TEMPERATURE

Temperature Instrumentation. New 46-page Catalog 6709 describes and illustrates remote-bulb thermometers, selection data, recorders and indicators, pneumatic control, electric control, program control, psychrometers, bulbs, tubing, and fittings.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Circle **420** on inquiry card.

Thermocouples. New 36-page illustrated Bulletin 235-5 gives description, specifications, dimensional drawings and installation diagrams of maker's large line of thermocouples.—Foxboro Co., Foxboro, Mass.

Circle **421** on inquiry card.

Immersion Thermocouples. New 8-page illustrated Bulletin gives features and description of maker's enclosed-tip thermocouples for molten-metal use.—L. H. Marshall Co., 270 W. Lane Ave., Columbus, Ohio.

Circle **422** on inquiry card.

Temperature Standards. Three new 1-page brochures present maker's calibration equipment and temperature standards—mercury, Glauber salt, metallic sodium, etc.—Weiller Instruments Corp., 95 Brood St., N. Y., N. Y.

Circle **423** on inquiry card.

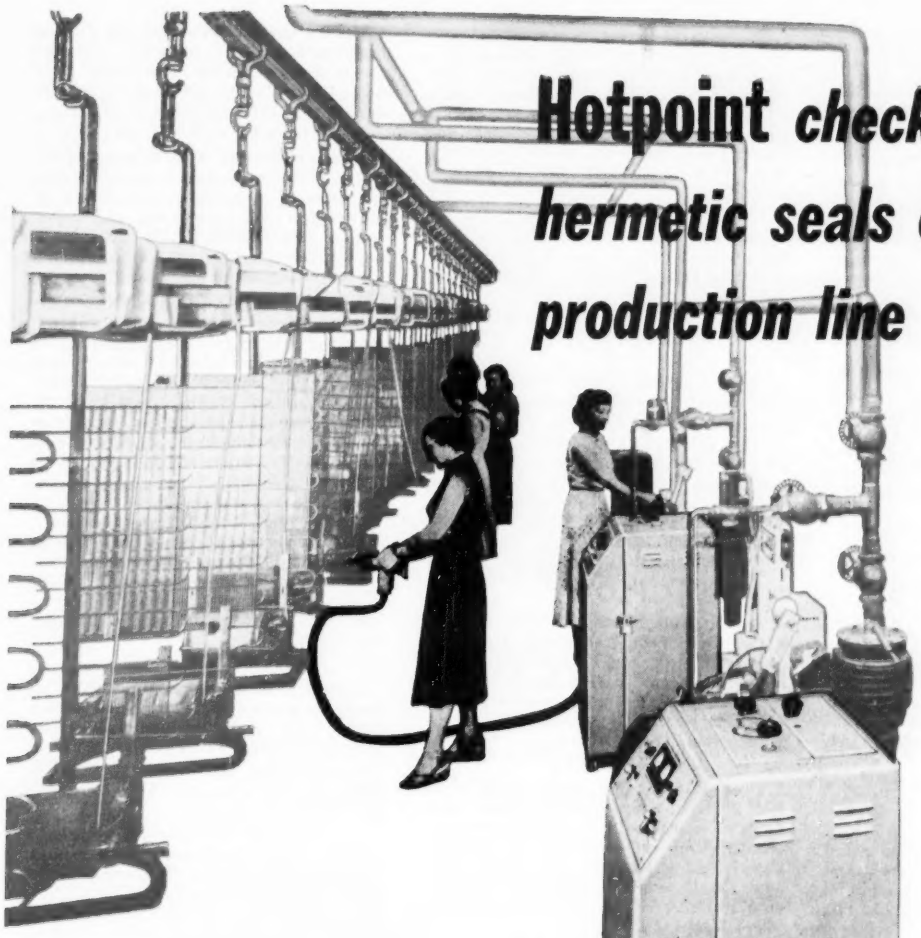
Pocket Pyrometer. New 4-page bulletin describes and illustrates maker's shock resistant pocketsize pyrometer. —Cybertronic Corp. of America, 136-8th St., Upland, Chester, Pa.

Circle **424** on inquiry card.

Indicating Pyrometer, Controller. New 2-page bulletins describe and illustrate maker's indicating pyrometers, and "Model 505" electronic high-temperature controller.—Cybertronic Corporation of America, 136-8th St., Upland, Chester, Pa.

Circle **425** on inquiry card.

Resistance Thermometery. New 16-page illustrated Catalog 5701 describes resistance thermometer bulbs of high speed, marine, room temperature and sanitary types for temperature spans



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NEW LITERATURE

as narrow as 20 deg. F.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Circle **426** on inquiry card.

Thermocouple and Extension Wires. New 6-page Specification Sheet 307 lists and describes sizes, accuracies, chemical compositions, weights, and prices of thermocouple and extension wires.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Circle **427** on inquiry card.

Thermal Safety Switch. New 24-page illustrated Bulletin presents data on maker's thermal warning control, aircraft-type thermal switch, fire detector, super-high-temperature thermal switch, and other switches.—Control Products Inc., 306 Sussex St., Harrison, N. J.

Circle **428** on inquiry card.

Chilling Equipment. New 8-page illustrated bulletin covers types, capacity, dimensions, construction and features of maker's industrial sub-zero chilling equipment. Includes tables of steel weights, volume, mass, and temperature conversion, and charts showing effects of sub-zero cooling on carbon steel containing austenite.—Mede Corp., P. O. Box 754, Highland Park, Ill.

Circle **429** on inquiry card.

PRESSURE

Blast Gage. New 2-page illustrated Bulletin P401 presents features and characteristics of maker's "Model P-401" blast gage.—Gulton Mfg. Corp., Metuchen, N. J.

Circle **430** on inquiry card.

Pressure Switches, Solenoid Valves. New 20-page illustrated Catalog 3G presents features, characteristics and ordering data on maker's "Shear-Seal" valves, four-way, dual pressure selector, shut-off models for pipe sizes to 1½ in., and solenoid valves.—Barksdale Valves, 5125 Alcoa Ave., Los Angeles, Calif.

Circle **431** on inquiry card.

Pressure Switch. New 2-page bulletin describes and illustrates maker's precision pressure switch, activated by a B-type bourdon tube, for use from 100 to 10,000 psi.—Miller-Robinson Co., 7007 Avalon Blvd., Los Angeles, Calif.

Circle **432** on inquiry card.

Vacuum, Pressure Testing. New 8-page illustrated Bulletin TE-53 presents principles of vacuum testing and pressure testing, equipment, methods and practical applications with maker's equipment.—Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis, Ind.

Circle **433** on inquiry card.

FLOW

Steam Measurement. New 2-page illustrated application Memo K19 presents description and features of maker's "Shuntflo" metering method for measuring steam load over wide range.—Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

Circle **434** on inquiry card.

Feed Pump. New 4-page Bulletin PM 20 describes and illustrates maker's chemical solution feed pump for chlorinating and fluoridation applications. Bulletin PM21 and PM30 present feed pump "Model S."—Precision Machine Co., 8 Walnut St., Somerville, Mass.

Circle **435** on inquiry card.

Sight Flow Indicators. New 2-page illustrated bulletin presents description of maker's "Full-View" sight flow indicators.—Jacoby-Tarbox Corp., 808 Nepperhan Ave., Yonkers, N. Y.

Circle **436** on inquiry card.

Positive Meters. New 20-page illustrated Bulletin 31 presents dimensions, principle of operation, and types of meters for oils, chemicals, and other liquids.—Buffalo Meter Co., 2917 Main St., Buffalo, N. Y.

Circle **437** on inquiry card.

Pumps, Valves, Fittings. New bulletin presents physical properties, chemical resistance data, performance data, performance data tables, and specification charts for maker's corrosion-resistant Buna-N and natural-hard-rubber pumps, valves, and pipe fittings.—Vanton Pump & Equipment Corp., Empire State Bldg., N. Y., N. Y.

Circle **438** on inquiry card.

LEVEL

Remote Level Indicator. New 4-page illustrated Bulletin 375 presents features and operation of maker's remote-reading "Keco" liquid-level indicator.—King Engineering Corp., Ann Arbor, Mich.

Circle **439** on inquiry card.

Liquid-level Gages, Valves. New 4-page illustrated Bulletin 0-218 covers maker's line of liquid-level valves and gages, including accessories, connections, remote gages, etc.—Jerguson Gage & Valve Co., 80 Fellsway, Somerville, Mass.

Circle **440** on inquiry card.

Sonic Level Indicator. New 8-page illustrated Bulletin S-68 presents principles and operation of maker's "SL-101 and -102" sonic liquid-level indicators that use echo-sounding principle for liquid-level indication.—Bogue Electric Co., Paterson, N. J.

Circle **441** on inquiry card.

WEIGHT

Sorter-Weigher. New 4-page illustrated bulletin presents operation, applications, specifications, maintenance, and service of maker's "Selectrol" check-weighing machine and sorter.—Exact Weight Scale Co., 944 W. Fifth Ave., Columbus, Ohio.

Circle **442** on inquiry card.

Weigh Feeder. New 4-page illustrated Bulletin 50-K57 covers features, operation and accessories of maker's "Model 50" low-rate disk feeder.—Omega Machine Co., 345 Harris Ave., Providence, R. I.

Circle **443** on inquiry card.

VISCOSITY

Ultrasonic Viscosity Measurement. New 4-page illustrated Data Sheet 10.13-2a presents description and applications of viscosity-measurement system that uses maker's "Electronik" recorder in conjunction with Bendix "Ultra-Viscoson" probe for measuring viscosity.—Minneapolis-Honeywell Regulator Co., Indus. Div., Phila. 44, Pa.

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Viscosity. New 4-page Bulletin TI 27-A-16b presents description, operating principle, specifications and construction details of "Viscometran"

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viscometer used with "Dynalog" recorder.—Foxboro Co., Foxboro, Mass.

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Viscometers. New 1-page illustrated bulletin presents features of Cannon-Fenske viscometers.—Scientific Development Co., Box 795, State College, Pa.

Circle **446** on inquiry card.

GAGING

Electronic Microcomparators. New 4-page illustrated Bulletin 536 gives features, specifications and description of components of maker's "Micro-AC" electronic microcomparator.—Cleveland Instrument Co., 735 Carnegie Ave., Cleveland, Ohio.

Circle **447** on inquiry card.

Ultrasonic Thickness Gages. New 4-page illustrated bulletin presents applications, range of thickness, accuracy, and characteristics of maker's ultrasonic-resonance thickness gages.—Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

Circle **448** on inquiry card.

Dial Indicators. New 16-page illustrated Catalog 106 gives description and prices of maker's line of dial indicators, test sets, depth gages and lens measures. Chicago Dial Indicator Co., 180 N. Wacker Dr., Chicago, Ill.

Circle **449** on inquiry card.

Dial Thread Plug Gage. New 2-page illustrated bulletin describes maker's roller thread pitch diameter comparator gage for inspecting internal threads.—George Scherr Co., Inc., 200 Lafayette St., New York, N. Y.

Circle **450** on inquiry card.

Micrometer. New 2-page illustrated Bulletin 4-2 presents features and specifications of maker's "Model 4-2" micrometer head.—Boeckeler Instrument Co., 61 E. Rillito St., Tucson, Ariz.

Circle **451** on inquiry card.

Inside-diameter Gage. New 2-page bulletin describes and illustrates maker's "Diametrick" inside-diameter gage "Model A" that will check diameters and grooves.—Mutual Engineering Service, 402 Court St., Saginaw, Mich.

Circle **452** on inquiry card.

Projection Comparator. New 8-page illustrated Bulletin 55 gives features, projection system, and specifications of maker's projection comparator.—Optical Gaging Products, Inc., 26 Forbes St., Rochester, N. Y.

Circle **453** on inquiry card.

Optical Gaging. New 4-page illustrated Bulletin 55SC presents principles of operation and features of maker's optical gages for shaft inspection.—Optical Gaging Products, Inc., 26 Forbes St., Rochester, N. Y.

Circle **454** on inquiry card.

Toolmaker's Microscope, Micrometer. New 4-page illustrated bulletins cover features, construction and operation of maker's toolmaker microscope and optical micrometer.—Boeckeler Instrument Co., 31 E. Rillito St., Tucson, Ariz.

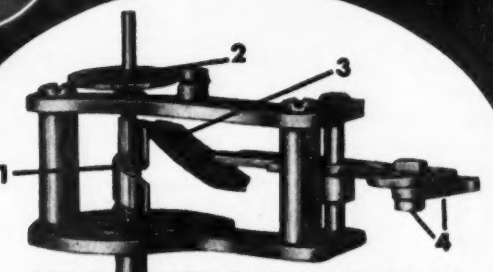
Circle **455** on inquiry card.

INSPECTION

Ultrasonic Inspection. New 4-page illustrated bulletin covers description,

ACCO products

HELICOID GAGES



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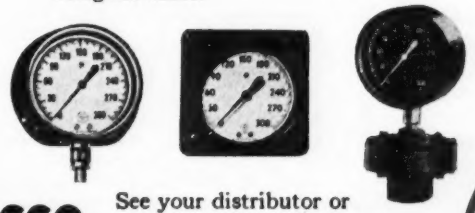

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NEW LITERATURE

operation, components and accessories of maker's immersed ultrasonic inspection equipment for charting sub-surface defects.—Electro-Circuits, Inc., 401 E. Green St., Pasadena, Calif.
Circle **456** on inquiry card.

Gamma-ray Fluoroscopy. New 4-page illustrated brochure presents operational procedure, features, and description of maker's gamma-ray fluoroscope for nondestructive testing. —Radioactive Products, Inc., 443 W. Congress St., Detroit, Mich.
Circle **457** on inquiry card.

Industrial Radiography. New 4-page bulletin presents use of gamma-ray emitters for industrial radiography. Includes comparison of radioisotope and X-ray methods.— St. John X-Ray Lab., Califton, N. J.
Circle **458** on inquiry card.

Environmental Test Equipment. New 4-page bulletin describes and illustrates maker's environmental test equipment to simulate low temperature, high temperature, humidity, and altitude.—Murphy & Miller, Inc., 1326 S. Michigan Ave., Chicago, Ill.
Circle **459** on inquiry card.

Hardness Testing. New 8-page illustrated Bulletin B 953 includes principle of operation, standards, models, and specifications for maker's Brinell hardness-testing machines and accessories.—Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit, Mich.
Circle **460** on inquiry card.

SURFACE ROUGHNESS

Pickup Drive. New 2-page Catalog Sheet ED 11702 presents description and specifications of maker's motor drive "Model BL-114" for mechanical tracing with maker's surface-inspection instrument.—Brush Electronics Co., 3405 Perkins Ave., Cleveland, Ohio.
Circle **461** on inquiry card.

Microfinish Comparator. New 4-page illustrated bulletin covers physical specimens, applications, principle and features of maker's new "S22" microfinish comparator—a surface-roughness scale.—Baptist Machine Co., Stamford. Conn.
Circle **462** on inquiry card.

STRAIN, ACCELERATION

Strain Gage. New 2-page illustrated Bulletin 4207 gives features, specifications, and dimensional sketch of "Whittemore" dial-micrometer hand strain gage.—Baldwin-Lima-Hamilton Corp., Phila. 42, Pa.
Circle **463** on inquiry card.

Accelerometer. New 4-page issue of "Instrument Notes" (No. 26) describes and illustrates design considerations for liquid rotor angular accelerometers.—Statham Laboratories, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.
Circle **464** on inquiry card.

Acceleration Pickup. New 2-page illustrated bulletin presents description, specifications and performance charts of maker's "Model A" vibration and acceleration pickup that uses self-generating barium titanata.—VibraShock, 5232 River Rd., Washington, D. C.
Circle **465** on inquiry card.

Accelerometer. New 1-page Bulletin A104 gives features of maker's "Models A104 and A104-2" accelerometers. —Gulton Mfg. Co., Metuchen, N. J.
Circle **466** on inquiry card.

Vibration, Acceleration Calibrating System. New 2-page illustrated Bulletin IB-2 gives components and description of maker's calibrating system for acceleration pickups.—Gulton Mfg. Corp., Metuchen, N. J.
Circle **467** on inquiry card.

COUNTING

Impulse Counter. New 4-page illustrated Bulletin 57002 covers technical data, description and dimensional drawings of distributor's small, remote impulse counters with zero resetting device.—Landis & Gyr, Inc., 45 W. 45 St., New York, N. Y.
Circle **468** on inquiry card.

Magnetic Impulse Counter. New 4-page bulletin describes and illustrates maker's magnetic impulse counter with impulse rate as high as 20 per second. Includes supplementary data sheet.—Kellogg Switchboard and Supply Co., 79 W. Monroe St., Chicago, Ill.
Circle **469** on inquiry card.

COMPUTING

Electronic Tally Computer. New 4-page illustrated Bulletin EL148 features and operation of maker's electronic "Speed Tally" which maintains 39,000 3-digit tally or inventory totals. —Remington Rand Inc., 315 Fourth Ave., New York, N. Y.
Circle **470** on inquiry card.

Computer Resolver. New 2-page illustrated Bulletin 5244-15T covers construction, description, function, technical data and specifications of maker's new "Size 15 Telesyn Resolvers" for control systems, computers, and data transmission.—Ford Instrument Co., 31-10 Thomson Ave., L.I.C. 1, N. Y.
Circle **471** on inquiry card.

Analog Simulator Computer. New 12-page illustrated bulletin gives features, principle of operation and specifications of maker's low-cost flexible "ANSER" analog simulator and computer.—Davis Laboratories Inc., 4705 Queensbury Rd., Riverdale, Md.
Circle **472** on inquiry card.

OPTICAL

Photographic Reproduction. New information kit contains folders giving directions on color photocopying, use of photocopy process, and explanation of maker's "Autostat" method.—American Photocopy Equipment Co., 1920 W. Peterson, Chicago, Ill.
Circle **473** on inquiry card.

Photographic Technique. New 12-page illustrated Bulletin 11-53L-KP Q-18 presents technique for converting continuous tone image to line drawing by means of maker's "Tone-Line Process."—Sales & Service Div., Eastman Kodak Co., 343 State St., Rochester, N. Y.
Circle **474** on inquiry card.

Microscope Lamp. New 4-page bulletin presents description and features of maker's microscope lamp.—Lindly & Co., 80 Herricks Rd., Mineola, N. Y.
Circle **475** on inquiry card.

RADIOACTIVITY

Nucleonic Instruments. New 8-page illustrated No. 4 issue of "The Nucleus" presents articles describing new methods for counting radioactive iodine in the measurement of thyroid function, isotope dilution analysis and a description of maker's radiochromatographic analyzer.—Nuclear Instrument & Chemical Corp., 223-233 W. Erie St., Chicago, Ill.

Circle **476** on inquiry card.

ANALYTICAL

X-ray Diffraction, Electron Microscope. New 64-page illustrated catalog presents features, descriptions, specifications, principles of operation, and applications of maker's large line of X-ray diffraction apparatus, goniometers, spectrographs, electron microscopes, and other analytical apparatus. —North American Philips Co., Inc., Mt. Vernon, N. Y.

Circle **477** on inquiry card.

Grating Spectrograph. New 4-page illustrated Catalog EB-10-53 presents principles and specifications of maker's "Ebert" 3.4-meter plane-grating spectrograph.—Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Circle **478** on inquiry card.

Microphotometer. New 1-page illustrated bulletin presents performance specifications and mechanical features of maker's new console microphotometer.—Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Circle **479** on inquiry card.

Infrared Gas Analyzers. New 4-page illustrated Data Sheet 10.15-10 presents application, method of operation and specifications for use of Liston-Becker non-dispersion-type infrared gas analyzers with Brown "Electronik" recorder.—Minneapolis-Honeywell Regulator Co., Industrial Div., Phila. 44, Pa.

Circle **480** on inquiry card.

Polarographic Analyzer. New 8-page illustrated bulletin gives features, method, principle and components of distributor's "Polaro-Analyzer for polarographic analysis.—Lovins Engineering Co., P. O. Box 429, Silver Spring, Md.

Circle **481** on inquiry card.

Infrared Spectrometer. New 6-page illustrated Bulletin 5M-12-53 covers description, features, operation, performance and specifications for maker's infrared spectrometer.—Perkin-Elmer Corp., Norwalk, Conn.

Circle **482** on inquiry card.

Distillation Packing and Columns. New 16-page illustrated bulletin gives distillation facts, tables of atmospheric and vacuum operation, plate design, and equipment for maker's distillation packings and columns.—Scientific Development Co., Box 795, State College, Pa.

Circle **483** on inquiry card.

LAB APPARATUS

Precision Balances. New 4-page illustrated Bulletin 329 covers distributor's line of precision chemical and micro-chemical balances with projection readings.—Burrell Corp., 2223 Fifth Ave., Pittsburgh, Pa.

Circle **484** on inquiry card.

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500B

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- **Direct monitoring while recording**
- **4 record speeds instantly selectable**

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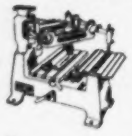

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NEW LITERATURE

Laboratory Planning. New 4-page Catalog SD-2 containing plastic guide rule and template with ¼ in. to 1 ft. scale with cutouts representing various laboratory base units; assists in planning layouts for all laboratories. Write on letterhead.—Metalab Equipment Corp., 224 Duffy Ave., Hicksville, L. I., N. Y.

Circle **485** on inquiry card.

Lab Homogenizer. New 1-page bulletin describes maker's laboratory homogenizer for preparation of fat emulsions for intravenous administration.—C. W. Logeman Co., 633 Bergen St., Brooklyn, N. Y.

Circle **486** on inquiry card.

Pipette Control. New 1-page illustrated bulletin presents features and use of maker's "Micropet" pipette control.—National Instrument Co., 5005 Queensbury Ave., Baltimore, Md.

Circle **487** on inquiry card.

Black Light. New 1-page bulletin presents features and uses of maker's black-light source for "Babcock" meniscus reader.—Vogel Luminescence Corp., 925 Harrison St., San Francisco, Calif.

Circle **488** on inquiry card.

Thermostated Oven. New 1-page bulletin presents features, construction and performance of maker's "Calibreg-1" thermostated oven.—Weiller Instruments Corp., 95 Broad St., New York, N. Y.

Circle **489** on inquiry card.

Camera Microscope. New 1-page bulletin presents maker's desk-type Reichert research camera microscope "MeF."—William J. Hacker & Co., Inc., 82 Beaver St., New York, N. Y.

Circle **490** on inquiry card.

Laboratory Apparatus. New 4-page illustrated Bulletin otM-11/53 describes maker's polyethylene laboratory apparatus including funnels, bottles, cylinders, jars and tubing.—E. Machlett & Son, 220 E. 23 St., New York, N. Y.

Circle **491** on inquiry card.

X-ray Quantometer. New 4-page issue, Vol. 6, No. 3 of "Spectrographer's News Letter" presents principle of operation, features, and uses of maker's multichannel X-ray Quantometer.—Applied Research Labs., Glendale 5, Calif.

Circle **492** on inquiry card.

Electron Microscope. New 12-page Bulletin 2J6851RE presents features, applications, principle, sample results, power, operation, and application of maker's "Type EMT" table-model electron microscope.—RCA, Engineering Products Dept., Camden, N. J.

Circle **493** on inquiry card.

Analytical, Electronic Instruments. New 4-page bulletin describes literature available on microscopes, electronic measuring instruments, optical tooling equipment, electronic stethoscopes, polaro-analyzers, interferometers, etc.—Lovins Engineering Co., P. O. Box 429, Silver Spring, Md.

Circle **494** on inquiry card.

Transmitting Gravitometer. New 2-page Bulletin 111-R2B presents "Arcco-Anubis" metameter transmitting liquid gravitometer that records by electrical impulse.—American Recording Chart Co., 3113 East 11 St., Los Angeles, Calif.

Circle **495** on inquiry card.

Constant-temperature Bath. New 4-page illustrated Bulletin 10 presents "Model 111-MS" constant-temperature bath.—Scientific Development Co., Box 795, State College, Pa.

Circle **496** on inquiry card.

Nitrogen Generators. New 4-page illustrated Bulletin 4240A presents maker's Nitroneal generator for producing pure nitrogen with controllable hydrogen content.—Baker & Co., Inc., 113 Astor St., Newark, N. J.

Circle **497** on inquiry card.

Hydrogen Dryer. New 6-page illustrated Bulletin 4119 gives features, of maker's "Deoxo" hydrogen dryer and purifier for catalytic purification and oxidation of gases.—Baker & Co., Inc., 113 Astor St., Newark, N. J.

Circle **498** on inquiry card.

ELECTRONIC INSTRUMENTS

Oscillator. New 4-page illustrated Bulletin MV-1b-6-53 presents maker's "Model MB-1" precision battery-operated oscillator for 2 to 20,000 cps.—Southwestern Industrial Electronics 2831 Post Oak Rd., Houston, Texas.

Circle **499** on inquiry card.

Stabilized DC Amplifier. New 4-page illustrated bulletin presents characteristics and operating instructions for maker's stabilized d-c. amplifier "Model 55" for preamplifier use.—Electro-Mechanical Research, Inc., Ridgefield, Conn.

Circle **500** on inquiry card.

Miniature Panel Indicators. New 2-page illustrated Data Sheet 11-1120 presents description and specifications for maker's miniature side-indicating panel meters for electrical measurements.—International Instruments Inc., P. O. Box 2954, New Haven, Conn.

Circle **501** on inquiry card.

Transductor Amplifiers. New 8-page Technical Data Bulletin TD 52-601 presents definition of terms, theory of operation, applications, and specifications of maker's transductor magnetic amplifier.—Westinghouse Electric, P. O. Box 2099, Pittsburgh, Pa.

Circle **502** on inquiry card.

Meter-relay Circuitry. New 8-page Bulletin 112 covers functions of eleven control and alarm circuits utilizing meter-relays.—Assembly Products Inc., Main & Bell, Chagrin Falls, O.

Circle **503** on inquiry card.

Voltmeter Inverter. New 1-page illustrated bulletin presents maker's voltmeter inverter "Model 214" that inverts small d-c. signals to a-c. signals.—Brunswick Instruments, P. O. Box 813, New Brunswick, N. J.

Circle **504** on inquiry card.

Decibel Measurement. New 8-page issue (Vol. 3, No. 1) of "Demodulator" presents explanation of dba, dbRN and

vu.—Lenkurt Electric Co., San Carlos, Calif.

Circle **505** on inquiry card.

Test Instruments, Components. New 16-page illustrated issue "This Month" (Jan.-Feb.) presents distributor's toggle and push-button switches, proportional mutual conductance tube checker, various meters, capacitors, and transformers.—Herbach & Rademan, Inc., 1204 Arch St., Phila., Pa.

Circle **506** on inquiry card.

Grid-dip Oscillator. New 2-page illustrated bulletin presents maker's UHF grid-dip oscillator, "Model 200" for 400 to 900 Mc.—New London Instrument Co., P. O. Box 189, New London, Conn.

Circle **507** on inquiry card.

Sweep-frequency Generator. New 2-page illustrated bulletin covers features, construction and specifications of maker's UHF sweep-frequency generator "Model 130" for 450 to 900 Mc. —New London Instrument Co., P. O. Box 189, New London, Conn.

Circle **508** on inquiry card.

Pulse Instruments. New 4-page illustrated Bulletin 1-53 covers types and applications of maker's multi-purpose pulse instruments with block unitization. Includes pulse generators, time delays, gates, etc.—Electro-Pulse Inc., 11811 Major St., Culver City, Calif.

Circle **509** on inquiry card.

Magnetic Amplifier. New 4-page bulletin presents maker's "Micromag" low-level magnetic signal amplifier that produces 5-v. output from 0.05 microwatt input.—Magnetic Research Corp., 318 Kansas St., El Segundo, Calif.

Circle **510** on inquiry card.

Message Repeater. New 6-page folder describes maker's small message repeater that consists of a recording and play-back device.—Michigan Electronics, 854 N. Rockwell, Chicago, Ill.

Circle **511** on inquiry card.

Peak Voltmeter. New 1-page illustrated Bulletin PTH-7-1 presents features and description of maker's "Peak-Meter" ballistic voltmeter which holds peak value of transients until reset.—Control Devices, Inc., 9918 Charlevoix Ave., Detroit, Mich.

Circle **512** on inquiry card.

Microwave Impedance. New issue (Vol. 2 No. 3) of quarterly "PRD Reports" summarizes methods for measuring microwave impedance with slotted sections.—Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn, N. Y.

Circle **513** on inquiry card.

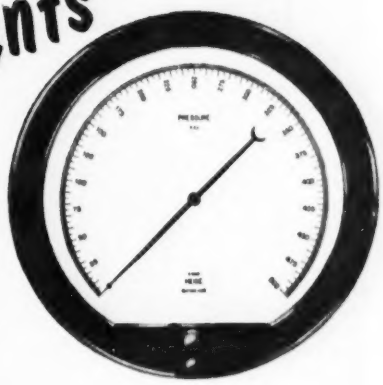
Hi-Fi Amplifier. New 4-page illustrated Bulletin 479-12-53 presents chassis and schematic drawings and conversion directions for high-fidelity "Williamson" amplifier.—Chicago Standard Transformer Corp., Addison and Elston, Chicago, Ill.

Circle **514** on inquiry card.

AC VTVM. New 1-page illustrated Bulletin presents maker's Model 1520" a-c. vacuum-tube voltmeter with ranges from 500 microvolts to 500 v. —Communication Measurements Lab., Inc., 350 Leland Ave., Plainfield, N. J.

Circle **515** on inquiry card.

New Developments



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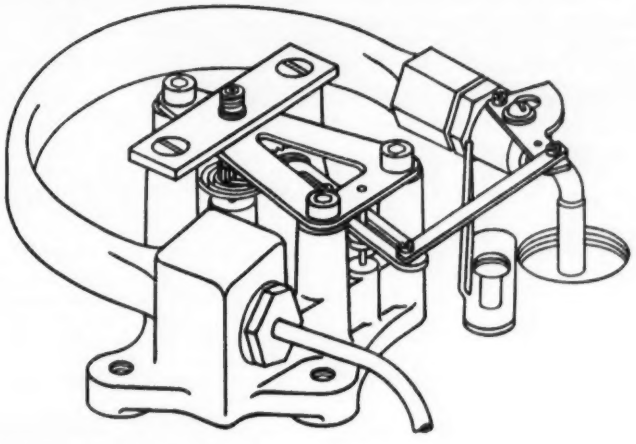

★ Permanent, positive accuracy of alignment guaranteed by integral construction.

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NEW "Lifetime" Dial Thermometers

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NEW LITERATURE

Delay Lines, Phase Detector. New bulletins present maker's miniature continuously variable delay lines, phase meters, step variable delay lines, and precision phase detectors.—Advance Electronics Co., 451 Highland Ave., Passaic, N. J.

Circle **516** on inquiry card.

Null Detector, Electronic Relay. New 2-page bulletins describe and illustrate maker's "Model 200A" electronic null detector, and "Model 300A" sensitive electronic relay.—Deltron Inc., P. O. Box 192, Glenside, Pa.

Circle **517** on inquiry card.

Electrical Measurements. New 8-page illustrated Bulletin AB 603a E presents distributor's line of Norma (Austrian) electrical measuring instruments including bridge, potentiometers, and switchboard instruments.—United Optical Mfg. Corp., 202 E. 19 St., New York, N. Y.

Circle **518** on inquiry card.

Microwave Calorimeters. New 2-page illustrated bulletin covers uses of maker's microwave calorimeter.—Sightmaster of California Co., Gillespie Airport, Santee, Calif.

Circle **519** on inquiry card.

Matching Amplifiers. New 1-page illustrated bulletin presents description, characteristics and specifications of maker's matching amplifier system "Model 100" for matching high-impedance pickups to conventional instruments.—VibraShock Corp., 5232 River Rd., Washington, D. C.

Circle **520** on inquiry card.

Ammeter Shunts. New 2-page illustrated Pat. Sheet DCS presents maker's new d-c. ammeter shunts.—Rapid Electric Co., 2881 Middletown Rd., New York, N. Y.

Circle **521** on inquiry card.

Decade Amplifier. New 2-page illustrated Bulletin F-408 presents features of maker's "Model F-408" decade amplifier.—Gulton Mfg. Corp., Metuchen, N. J.

Circle **522** on inquiry card.

POWER SUPPLIES

Transistor Power Supplies. New 4-page illustrated bulletin presents requirements, features and discharge charts for maker's miniature batteries for use with transistors.—Burgess Battery Co., Freeport, Ill.

Circle **523** on inquiry card.

Power Supplies. New 4-page bulletins present features and specifications for maker's low-voltage, high-current d-c. power supply and precision computer power supply.—Magnetic Research Corp., 318 Kansas St., El Segundo, Calif.

Circle **524** on inquiry card.

Power Supplies. New 4-page illustrated bulletin presents maker's absolute d-c. regulated power supplies.—Kalbfell Labs., Inc., 1090 Morena Blvd., San Diego, Calif.

Circle **525** on inquiry card.

MOTORS

Speed Control. New 8-page illustrated issue Vol. 28 No. 7 of "General Radio Experimenter" presents 5 new speed controls for motors.—General Radio Co., 275 Massachusetts Ave., Cambridge, Mass.

Circle **526** on inquiry card.

Sub-fractional-hp. Motors. New 12-page and 2-page bulletins describe and illustrate maker's sub-fractional-hp. motors, including universal, direct current, and induction types.—Howard Industries, Inc., Racine, Wis.

Circle **527** on inquiry card.

Miniature Motors. New 26-page catalog describes and illustrates maker's line of small d-c. motors from 1/1000 to ½ hp.—Motordyne, Inc., 2661 S. Myrtle Ave., Monrovia, Calif.

Circle **528** on inquiry card.

RELAYS, SWITCHES

Relay Symposium. New 70-page bulletin contains papers presented at "Symposium on Electro-Magnetic Relays" given at Oklahoma Institute of Technology. Covers design and operation of all type relays.—Potter & Brumfield, Princeton, Ind.

Circle **529** on inquiry card.

Time-delay Relay. New 4-page Bulletin SR4 describes and illustrates maker's two-step pneumatically-controlled time-delay relay available with SPDT or DPDT contacts.—AGA Division, Elastic Stop Nut Corp. of America, Elizabeth, N. J.

Circle **530** on inquiry card.

Switches. New 4-page illustrated issue (Vol. 1, No. 12) of "Micro Tips"

presents practical applications of maker's "Micro" switches in textile mills, safety devices and electronic instruments operating in explosive atmospheres.—Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Circle **531** on inquiry card.

Explosion-Proof Switches. New 2-page illustrated Data Sheet gives features and ratings of maker's explosion-proof "Micro" switches.—Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Circle **532** on inquiry card.

POTENTIOMETERS

Servo-driven Potentiometers. New illustrated 8-page bulletin "Computing with Servo-driven Potentiometers" covers linearity and loading effects in analog systems and explains how errors can be eliminated.—Helipot Corp., S. Pasadena, Calif.

Circle **533** on inquiry card.

Potentiometer. New 6-page Brochure 3591 describes features, specifications, resistance values and outline drawings of maker's "Trimpot" subminiature trimming potentiometer.—Dept. NL, Bourns Labs., 6135 Magnolia Ave., Riverside, Calif.

Circle **534** on inquiry card.

Potentiometers. New 6-page illustrated Bulletin C-200 presents features, applications, general specifications, and resistance values of maker's 2-in. high-precision potentiometers.—DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City, N. Y.

Circle **535** on inquiry card.

Power Resistors. New 2-page illustrated Bulletin EP-5 presents features, ratings, and values for maker's "Cool Blue" power resistors.—General Electric Co., Electronics Div., 1811 LeMoyne Ave., Syracuse, N. Y.

Circle **536** on inquiry card.

Resistors, Potentiometers. New 2-page issue (Oct.-Nov.) "Ohmite News" presents descriptions of maker's potentiometers, rheostats, thin resistors, and resistance boxes.—Ohmite Mfg. Co., 3603 Howard St., Skokie, Ill.

Circle **537** on inquiry card.

Potentiometer. New 1-page bulletin presents distributor's miniaturized "Model D" single-turn wire-wound "Milli-Torque" potentiometer.—F. H. Paul & Stein Bros., Inc., 100 Gold St., New York, N. Y.

Circle **538** on inquiry card.

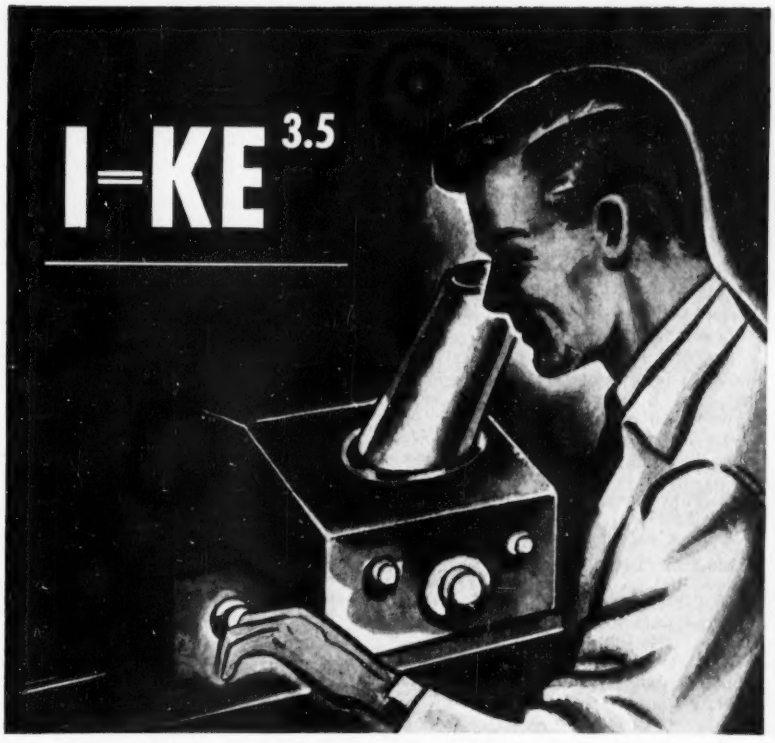
Resistors. New 2-page illustrated Bulletin P-2 covers characteristics, ratings, tolerances, charts and graphs for maker's power resistors, "Types PW-7 and PW-10".—International Resistance Co., 401 N. Broad St., Phila., Pa.

Circle **539** on inquiry card.

TRANSISTORS, TUBES

Junction Transistors. New 6-page data sheet presents ratings, characteristics, and operation of maker's n-p-n junction transistors, "Types RD-2517A, RD-2520A, RD-2521A, RD-2525A."—Germanium Products Corp., 26 Cornelison Ave., Jersey City, N. J.

Circle **540** on inquiry card.



Problem: To hold I (light intensity) at a constant value when E (voltage) has random variation of ± 10%

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Whether E or its equivalent in any formula is AC (60-cycle or 400-cycle) or DC, Sorensen electronic regulating equipment is designed to make the results of your work more accurate and your time more fruitful. Instruments are available from stock to fit a very large variety of applications.

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NEW LITERATURE

Twin Tetrode. New 26-page illustrated booklet presents performance curves and description of maker's twin-tetrode tube "Type 5894/AX-9903."—Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle **541** on inquiry card.

Multiplier Phototube. New 6-page bulletin covers general characteristics, physical characteristics, operating characteristics, and performance charts for maker's five new multiplier phototubes.—Allen B. DuMont Labs., Inc., 1500 Main Ave., Clifton, N. J.

Circle **542** on inquiry card.

Multiplier Phototube. New 8-page illustrated Bulletin 6328-10-53 covers general description, definition of terms, and characteristics for maker's new 9-stage multiplier phototube "Type 6328" with S-4 response for headlight control service.—Tube Dept., RCA, Harrison, N. J.

Circle **543** on inquiry card.

Electron Tubes. New Bulletins 21-ZP4-A, 6AU4-GT, 6263 and 6264 cover tentative technical data, characteristics and performance of maker's new kinescope, half-wave vacuum rectifier and UHF medium-mu triode.—Tube Dept., Radio Corp. of America, Harrison, N. J.

Circle **544** on inquiry card.

Grounded-grid Amplifier. New 4-page illustrated issue (Vol. 1, No. 9) of "Engineering Information Service" presents performance of 6AN4 grounded-grid amplifier at 500 Mc.—Sylvania Electric Products Inc., 1100 Main St., Buffalo, N. Y.

Circle **545** on inquiry card.

ELECTRONIC COMPONENTS

Instrument Transformers. New 96-page Buyer's Guide presents ratings, ASA accuracy classifications, and prices of maker's large line of instrument potential and current transformers.—General Electric Co., Schenectady 5, N. Y.

Circle **546** on inquiry card.

Plug-in Decade Inductors. New 2-page illustrated bulletin lists features, description, mechanical data, characteristics and frequency chart of maker's new decade inductors featuring plug-in precision toroids that can be combined in any number.—Burnell & Co., Yonkers 2, N. Y.

Circle **547** on inquiry card.

Connectors. New 12-page illustrated Bulletin AN-E-1 describes maker's new "Series E" lightweight, vibration-proof connectors.—Cannon Electric Co., 3209 Humboldt, Los Angeles, Cal.

Circle **548** on inquiry card.

Connectors. New 4-page issue of "Engineering News" (Nov.-Dec., 1953) presents articles on computing velocity of propagation of coaxial cables, origin and use of decibel.—American Phenolic Corp., 1830 S. 54 Ave., Chicago, Ill.

Circle **549** on inquiry card.

Sockets, Tube Shields. New Bulletins MS-1, -2, -3, -4, -5 and -6 and SS-3 present features, mountings and specification of maker's 7- and 9-pin UHF, miniature, and JAN-type sockets and test shields.—Sylvania Parts Div., Warren, Pa.

Circle **550** on inquiry card.

Permanent Magnets. New 4-page bulletin describes and illustrates maker's facilities for manufacture of permanent magnets. Includes design considerations and chart on average characteristics.—General Magnetic Corp., 10003 Erwin Ave., Detroit 6, Mich.

Circle **551** on inquiry card.

Clip-on Test Probe. New 4-page bulletin describes and illustrates maker's test probe that can be instantaneously clipped to circuit.—Mic-Con, Inc., 521 Lehigh Ave., Union, N. J.

Circle **552** on inquiry card.

Beginner's Electricity Kit. New 6-page illustrated bulletin presents distributor's line of basic experimental kits for teaching principles of electricity in high schools. Free text-manual is offered.—Universal Scientific Co., 1102 Shelby St., Vincennes, Ind.

Circle **553** on inquiry card.

Modular-design Kit. New 1-page illustrated bulletin presents features of maker's "Project Tinkertoy" modular-design kit "Type PT-100."—Communication Measurements Lab., Inc., 350 Leland Ave., Plainfield, N. J.

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Pilot Lights. New 22-page illustrated Catalog 8P presents specifications and dimensions of maker's dial

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and jewel pilot-light assemblies.—Drake Mfg. Co., 1713 W. Hubbard St., Chicago, Ill.

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Dielectric Coil Bobbins. New 4-page illustrated bulletin gives features, description and specifications of maker's precision coil bobbins made of dielectric paper and materials.—Precision Paper Tube Co., 2033 W. Charleston St., Chicago, Ill.

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TUBING, FITTINGS

Plastic-tube Fittings. New 4-page illustrated Bulletin 3025-A covers features, accessories, types, sizes and specifications of maker's tube fittings and accessories for plastic tubing.—Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill.

Circle **557** on inquiry card.

Flexible Tubing. New 8-page illustrated bulletin "Flexineering" presents applications of maker's flexible tubing and complete engineering data. Write on Company Letterhead.—Pennsylvania Flexible Metallic Tubing Co., 72nd St. and Powers Lane, Phila., Pa.

Circle **558** on inquiry card.

FABRICATION

Fabrication, Closures, Panels. New 4-page illustrated Bulletin 142 gives features and applications of maker's line of metal cabinets for electronic, chemical, and instrument use.—Falstrom Co., Falstrom Court, Passaic, N. J.

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Precision Fabrication. New 8-page illustrated issue of "Daco Doings" (winter 1953-54) presents maker's achievement in designing chronometer-comparator for Coast Guard, facilities, and built-to-order instruments.—Daco Machine & Tool Co., 2002 Tillary St., Brooklyn, N. Y.

Circle **560** on inquiry card.

Rhodium Electroplating. New 24-page illustrated Bulletin "Electroplating with Rhodium," gives applications and general instructions for electroplating with rhodium.—Baker & Co., Inc., 113 Astor St., Newark, N. J.

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MATERIALS

Molded Rubber. New 158-page illustrated catalog presents facilities, production, glossary of terms, methods and products of maker specializing in molded and stock, die-extruded and fabricated, rubber parts.—Atlantic India Rubber Works, Inc., 571 W. Polk St., Chicago, Ill.

Circle **562** on inquiry card.

Industrial Cork. New 4-page illustrated Bulletin S-54 presents physical characteristics, government and SAE-ASTM requirements, sheet sizes and thicknesses and typical products for maker's natural and composition cork.—Dodge Cork Co., Inc., Lancaster, Pa.

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Coated Fabrics. New 6-page illustrated bulletin describes maker's line of coated materials such as Buna-N-coated nylon, Neoprene-coated cotton and vistanex-coated silk.—Haartz-Mason, Inc., Watertown 72, Mass.

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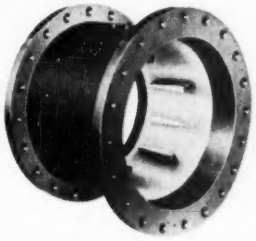

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NEW LITERATURE

SHOP EQUIPMENT

Taps, Dies, Screws. New 8-page illustrated bulletin supplies data on maker's small taps, dies, screws, drills, gages, and punches for instrument use.—J. I. Morris Co., 394 Elm St., Southbridge, Mass.
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Wire Stripper. New 2-page illustrated bulletin presents description of maker's high-speed wire stripper.—High Speed Hammer Co., Inc., 313 Norton St., Rochester, N. Y.
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Precision Drilling Machine. New 4-page bulletin presents capacity, cross-sectional view, and specifications of maker's "Model R-53" high-speed drilling machines.—High Speed Hammer Co., Inc., 313 Norton St., Rochester, N. Y.
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Soldering Tools. New 1-page illustrated bulletin presents features and price list of maker's new "Model J-5 and Model J-4" instant-heat resistance-type soldering units.—Vemaline Products Co., P. O. Box 222, Hawthorne, N. J.
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Pocket Slide Rule. New pocket-size slide rule of heavy-gauge plastic with transparent runner carries most-used A, B, C, D, and C1 scales, has one edge calibrated in sixteenths, the other in millimeters; reverse side bears Ohm's Law formulae and temperature-conversion scale.—Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.
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Decimal-equivalent Chart. New 3⅜ by 5½ inch plastic card lists decimal equivalents of fractional parts of an inch to 6 places.—South Bend Lathe Works, South Bend 22, Ind.
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Automatic Screw Machines. New 34-page bulletin presents line of "Traul" automatic screw machines, turning and copying automatics, and automatic chip separating machines. Includes price list.—Guthery Machine Tool Corp., 130 W. 42 St., New York, N. Y.
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Tapping Attachment. New 8-page illustrated Bulletin 101 covers features of maker's lead-screw tapping attachment.—Automatic Methods, Inc., 965 W. Grand St., Elizabeth, N. J.
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Microfilm Card-Sort File. New 2-page bulletin describes maker's method for filing, attaching, and removing microfilm strips from file and punch cards.—Picturesort Co., 246 Church St., New Haven, Conn.
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Company History. New 4-page illustrated bulletin is reprint giving history of manufacturer on 10th anniversary of founding.—Conoflow Corp., 2100 Arch St., Phila., Pa.
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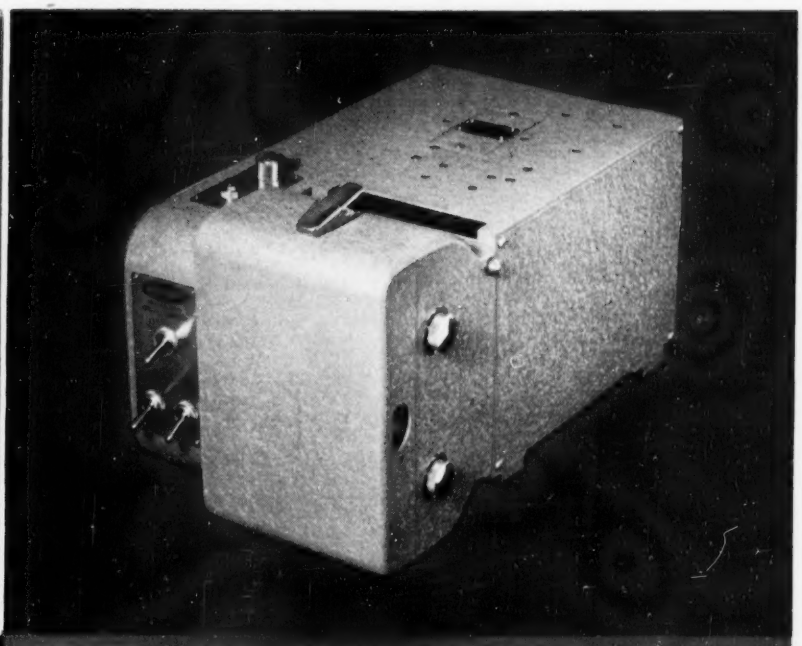

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